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REMARKS ON THE MAELSTROM.

On the coast of Norway, in latitude 68°, is a tremendous whirlpool, commonly called Maelstrom.* Its violence exceeds that of a cataract, being heard at a great distance, without intermission except at the time of high and low water, when its impetuosity seems at a stand: this tranquillity, however, seldom continues over 15 minutes, when its violence returns, gradually increasing to such a tremendous draught and vortex that it absorbs whatever comes within the sphere of its influence. The whirlpool is of such extent and depth, that whenever a ship comes within its attraction, it is inevitably precipitated and dashed in pieces against the rocks below, and when the water relaxes the shattered fragments appear at the surface.

From this circumstance, several able writers imagine that here is an abyss which penetrates the earth, issuing in some very remote parts—a supposition which, although it may at first appear plausible, is in itself not only entirely hypothetical, but also in direct opposition to established laws in physico-mathematical science.

It need not be remarked that the earth is nearly in the form

* Not unfrequently called Moskoestrom, from Moscoe an adjacent island.

of an oblate spheroid—the equatorial being about 26 miles greater than the polar diameter.

Now let us suppose that two perforations, the one AB proceeding from some point on the equator, the other CD from one of the poles, intersect each other at the centre.* Conceiving each of them to be filled with water, (although by hypothesis the altitude of AB is 13 miles greater than that of CD) the one would exactly balance the other. For, while CD is relatively at rest, AB partakes of the centrifugal force of the earth (rotating on its axis) which produces a diminution in the gravity of AB exactly corresponding to the excess thereof in altitude.†

Bishop Pontoppidan observes, that the Maelstrom has no other cause than the collision of the waves rising and falling, at the flux and reflux against the rocks and shelves, which confine the water in such a manner that it precipitates like a cataract; accordingly, the higher the flood rises, the deeper must be the fall, the natural result of which is a whirlpool. Mr. Ramus is of the same opinion, and remarks that at the time of flood, the streams run up the country between the islands of Lofoden and Moscoe with tremendous rapidity. J. P.

New-York, September, 1841.

[For the American Repertory.]

LYCEUM OF NATURAL HISTORY.

PROCEEDINGS.

January. Dr. Smith exhibited a dissected head of the Turkey Buzzard, and made some observations on the olfactory nerve, the existence of which is denied by Mr. Audubon. The dissection of the brain presents the olfactory nerves arising from the

* The extremities of the supposed perforations are restricted to the surface of the ocean. A line drawn from the centre of the earth to some point on the equator would be the longest possible radi; also, a line drawn from the centre to one of the poles would be the least; accordingly, our supposition could not be more favorable.

† For if not, there must be a difference; of the two, we will first suppose that the diminution in gravity is less; the water would descend in AB and rise in CD; the same course would produce an efflux of water at the equator, and an influx at the poles, which is absurd. In a similar manner, if the diminution in gravity were greater, the water would fall in CD, and rise in AB, the cause of which would produce an efflux of water at the poles, and an influx at the equator.

anterior portion of each anterior lobe of the cerebrum. They are found running on the ethmoidal plates, and sending down through a membrane, which is the analogue of the cribriform plate, a great number of nervous fibrillæ. These may be seen, on a close inspection, to be distributed upon the Schneiderian membrane, as it is widely extended on the numerous convolutions of the turbinated bones, or, more properly speaking, cartilages; for in this bird, cartilaginous expansion takes the place of that which is of bone in man and many of the mammalia.

These nerves look like prolongations of the cerebral lobes, though a well defined line marks the spot where the brain ends and the nerves begin. We may estimate the brain of man at $\frac{1}{40}$ of his whole weight, and the brain of this bird at $\frac{1}{260}$ of its weight; but the olfactory nerves of man are scarcely as large as those of this bird; yet the amount of surface which receives this distribution of the nerve of specific sense is smaller in the Buzzard than in man.

The dissection likewise presents the internal nasal branch of the ophthalmic nerve, itself the first branch of the fifth pair. This olfactory nerve of the fifth pair of nerves passes through the os planum of the ethmoid bone at the anterior internal orbitary foramen, and gives to the Schneiderian membrane common sensation. This is larger even than in man, and is as large as the third primary division of the trigeminous. The optic nerves are found to be very large, but not so large as the olfactory in proportion to the brain, or the same nerve in man. On the whole, we find an enormously developed olfactory apparatus, outstripping its ordinary relation to that of vision.

Dr. Lee gave an account of a stream at Salisbury, Ct. which commences freezing at the bottom and gradually freezes upward to the surface. This stream is about two miles long, and descends a mountain 1800 feet high, and is very rapid. He attributed the phenomenon to the rapid motion of the water, which allows portions of the water at the bottom to be reduced to a lower temperature than the surface, and to their being in contact with the ground, which is colder than the water.

Mr. W. C. Redfield exhibited a table and sketch illustrative of the great storm of December, 1839. The table exhibited the

result of forty observations made at different places at noon, or reduced to that hour from several observations made at different hours of the day. The sketch showed the path of the storm, and also the direction of the wind at various places. He made some observations upon the effects of the storm, and announced his intention of publishing a summary account of it.

Prof. Johnston read a description of a new species of Beryl, recently discovered at Haddam, Ct.

Dr. Jay, to whom was referred the map of the French Antarctic discoveries, presented by Count Castlenau, reported as follows:—

It is well known that the U. S. Exploring Squadron, commanded by Lieut. Wilkes, discovered land, supposed to be part of a southern continent or large island, in 1840. The French corvettes L'Astrolabe and La Zélée, under the command of M. Dumont D'Urville, were employed on a similar service, and it is remarkable that they also saw land at nearly the same time, on what is supposed to be the same coast, though at a considerable distance from the point discovered by the Americans. On the 21st of January, 1840, they landed on a shore to which they gave the name of Terre Adelie, and where they made observations on the magnetic needle. This shore was covered with immense masses of ice, from 364 to 450 metres high above the level of the sea. It lies between 66° and 67° south latitude, and was traced from about $139\frac{1}{2}°$ to 134° E. from Paris. On the 30th they again discovered land, or rather a fortification of ice, supposed to rest on some solid foundation, between 64° and 65° S. and 129° and 131° E. This they named Coté Clarie. A large chart of these discoveries has been published at Paris by M. Vincendon Dumoulin, the engineur hydrographe on board L'Astrolabe, which contains also views of the coast. When the transactions of the two squadrons appear they will be read with interest, as furnishing gratification to a liberal curiosity, and affording materials for a more accurate description of our globe, and perhaps for improving our knowledge of magnetism, which now more than ever attracts the attention of scientific men.

The following works have been received during the month:

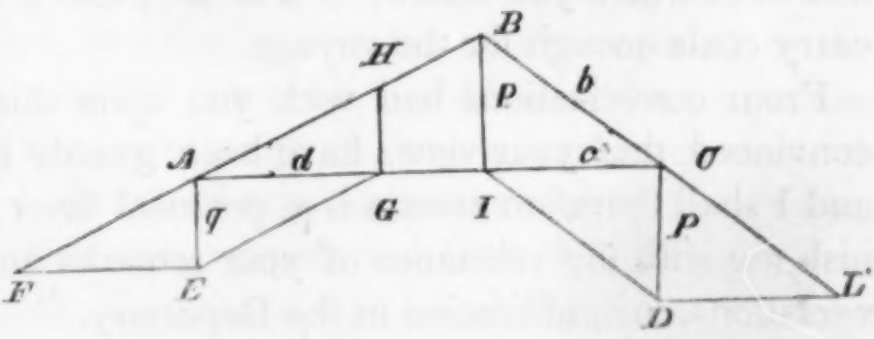
Thornton's Elements of Botany, from Mr. Stillman. Bibliotheca Americana for 1840, from Mr. Warden of Paris. Catalogue of books, pamphlets and maps added to the Library of the Hist. Soc. since January 1839, from Dr. De Kay. Audubon's Birds of America, No. 24. Elements of Chemistry, by Prof. Johnston, from the author. Notices of European Herbaria, from Dr. Gray. Elements of Entomology, by Count Castlenau, from the author. A Map, showing the discoveries of the French Antarctic Exploring Expedition, from Count Castlenau. Final Report of the Geological Survey of New-Jersey, from W. C. Redfield. The American Repertory, No. 6, Vol. II, from the editor.

The following additions have been made to the cabinet: A gigantic Modiola, having on the outside a curious animal—presented by Mr. Gibbs. Several reptiles and crustacea, by Mr. Brevoort. Rose Quartz, from East Haddam, presented by Mr. Wheatley. Common hematite, specular oxide of iron, stalactitic argillaceous oxide of iron, hematite in cubic crystals, from Salisbury, Ct.—this last has never been found before in this country—presented by Dr. Lee. A dissected specimen of the eye of the Common Cod, (Gadus Morhua) by Dr. Goldsmith, who stated that the optic nerve had no visible connection with the retina. B.

For the American Repertory.

NEW DEMONSTRATION OF THE THEORY OF THE LEVER.

Let ABC be a bent lever, of which the point B is fixed. Let the weight p be applied to the extremity C, and the weight q at A. Also, let the line CD, which is equal to BI, represent the direction and intensity of the force p, and AE that of the force q, the points A and C being in the same horizontal line. The force p may be resolved into the two



components CL and CI, of which the first is destroyed by the resistance of the point B, and the other acts along the line CA. In the same manner, the force q applied at A may be resolved into the two components AF and AG, of which the first is destroyed by the resistance of the fixed point B, and the other acts along the line AC. The partial forces of p and q, resolved in the direction of AC, must be equal, because by hypothesis theforces p and q are in equilibrium.

To estimate these forces, let BC$=b$, AB$=a$, and BCA$=c$, and the angle BAC$=d$; then IC$=b\cos c$; and AH : q : : AB : p $\therefore$ AH$=\frac{a\,q}{p}$; hence AG$=\frac{a\,q}{p}\cos d$; consequently we have $\frac{a\,q}{p}\cos d=b\cos c$, which expresses the law of equilibrium for a bent lever. Now when the angles c and d become each of them $=o$, the bent lever becomes straight, and the above equation reduces to $\frac{a\,q}{p}=b$, or $aq=pb$; which expresses, that when the two weights p and q are in equilibrio, they are reciprocally proportional to their distances from the fulcrum B.

B. BIRDSALL.

Clinton, Oct. 22, 1841.

CORRESPONDENCE BETWEEN DR. LARDNER AND THE EDITOR.

DR. LARDNER :—

Dear Sir—It has been currently reported, as you are aware, that before an attempt was made to establish a line of steam ships between this continent and England, you expressed opinions unfavorable to the success of such a project. This report grew out of some remarks made by you before the British Association for the Advancement of Science, in the course of which you stated, as it is said, that a vessel could not carry coals enough for the voyage.

From conversations had with you upon this subject, I am convinced that your views have been grossly misrepresented; and I shall therefore esteem it a personal favor if you will furnish me with the substance of your remarks during those conversations, for publication in the Repertory.

I am, Sir, yours respectfully, J. J. MAPES.

New-York, Oct. 10th, 1841.

PROF. MAPES:—

Dear Sir—I am quite aware of the popular error which has prevailed respecting the opinions I have expressed on the subject of the application of steam power to the Atlantic voyage, and have felt some surprise that one of the earliest and most zealous advocates of that enterprise could be believed to express any opinion so absurd as that it was "physically impossible to cross the Atlantic by steam power." The imputation of a grand error, committed by a professor of practical science, is too amusing and too stimulating a subject for the public, to be quietly surrendered merely for the sake of sober truth; and unless there prevail on this side of the Atlantic a much more active spirit of justice and liberality among the people, and a much more decisive preference for what is true over what is exciting, I fear your efforts to correct this popular error will be unavailing. Nevertheless, in compliance with your request, I will state, as briefly as is consistent with clearness, the circumstances out of which this report must be presumed to have arisen.

It is perhaps known to those who interest themselves in the general diffusion of knowledge, that at the annual meetings of the British Association for the Advancement of Science, one or two evenings are set apart for addresses or discourses on subjects of popular interest, to hear which large audiences are usually assembled. At the meeting of the Association, held in Dublin, in the year 1835, the duty of addressing the assembly on one of these evenings was assigned to me, and the subject of the discourse was the application of steam power to transport by land and water, and its prospective advantages. This lecture was delivered in the Rotunda, before an audience of about 3000 persons. It was on this occasion, according to the best of my recollection, that the application of steam power to the Atlantic voyage was first discussed in public. I then urged the practicability of the project with all the zeal and force of which I was master. I addressed arguments drawn from the general principles of mechanical science, and from the analogies supplied by the results of steam navigation on the European seas, to prove that a reasonable expectation, and such a one as would

justify the investment of capital, might be entertained of the successful issue of such a project. I maintained that, although the Atlantic had been already twice crossed by an American steam ship, (the Savannah) and *therefore the mere practicability of such a voyage could not be questioned*, yet as the passage was many times greater in length than any regular and constant steam voyage, which had been theretofore established, prudence would dictate the expediency of abridging its length as much as possible, by taking, as a point of final departure, the most western coast of Ireland, and as a point of first arrival, the nearest practicable harbor of the western continent: Halifax was mentioned for this purpose, as an intermediate station on the route to New-York, and one which would insure for the enterprise the advantages and support of the British post-office contract. I recommended the harbors of Valentia and Galway, and I believe one or two others, as points of departure.

This part of the address excited a strong feeling at the time in Dublin and throughout Ireland, especially as I urged the expediency of the government lending its support to construct a railway across that country, by which the stream of intercourse already carried by steam power from London to Dublin might be continued to the western point of departure for America. It will be remembered by those who happened to be at the time in Dublin, how much public attention this part of the lecture attracted, and that a phrase which I used, incidentally, to the effect that "the day was fast approaching on which Ireland would become a part of a great high-road between London and New-York," became so popular that it was quoted in public speeches and toasted at public dinners. I refer to this circumstance (in itself unimportant) merely as evidence of the opinion then expressed by me.

What I have above stated may be verified in substance, if not in detail, by reference to the Dublin newspapers.

The British Association held its meeting the following year (1836) in Bristol, when it fell to my lot to resume the question of the Atlantic voyage. Meanwhile, the commercial interests of the two great British marts, Liverpool and Bristol, were awakened to the importance of Atlantic steam navigation; but

these towns, rejecting those parts of the plan advocated by me, which recommended the west coast of Ireland as the point of departure on the European side, and Halifax as an entrepôt, contemplated at once an unbroken trip between England and New-York. To this I was opposed, not because I considered it impracticable, but because, as I stated at Bristol, I considered that the certainty, regularity and economy of the line of communication, its continued operation through all seasons of the year, and, above all, the advantage it would reap from the post office contract, which by touching at Halifax it would command, formed prudential motives sufficiently strong to turn the scale in favor of the plan which I advocated. I then urged the superior advantages which would attend the adoption of Bristol and Liverpool as intermediate stations, to be connected by lines of railway from Waterford and Dublin, converging to a common point on the west coast of Ireland, Bristol forming the outlet for the southern, and Liverpool for the northern division of Great Britain. I endeavored to show, from the practical working of the Admiralty steamers, (the only ones from which any clear or certain information could be obtained) that in the actual state in which marine engines then were, it was extremely improbable that a steam vessel could work between New-York and England, in one unbroken voyage, *throughout all seasons of the year, with such a profit on the capital as would insure the continuance of the enterprise.* I stated that, if it were attempted, *it would probably have to be discontinued during the winter months;* and that even with that qualification I regarded the project not without feelings of considerable apprehension; that, on the other hand, *the adoption of Halifax as an entrepôt, the consequent subsidy which would come from the English post office, and the further abridgment of the trip by departing from the west coast of Ireland, would afford every reasonable ground for expecting the establishment of a regular, certain, expeditious and profitable line of communication between Great Britain and the United States.*

I am not ashamed to acknowledge that the zeal with which I engaged in the discussion of this question, and the perseverance with which I pressed upon the public the advantage of adopting the west coast of Ireland as a point of departure, was heightened

by the prospect of the great benefits which it would bring to that part of the British empire to which I owed my birth, and which for ages has groaned under that oppression which England has been so remarkable for exercising over her dependencies and colonies. I did feel that if, without violating truth, I could urge the Government into a measure which would send across Ireland the great stream of civilized intercourse which so rapid and easy a communication as steam power was likely to establish between the United States and Europe, I was justified in using the last resources which the reasoning and persuasion of an advocate could supply for the purpose. I acted accordingly, and brought down upon myself by so doing a spirit of animosity in England, in which, doubtless, originated the fabrication of those absurd reports which you have requested me to account for and contradict.

The events which have succeeded these discussions are well known. Five steamships, to the best of my recollection, have been started between the ports of England and New-York, the Great Western, the Sirius, the Liverpool, the British Queen, and the President. Of these, three have been withdrawn, and one lost at sea. The Great Western alone has continued in operation, being suspended during the winter season. On the other hand, a line of steamers has been established, with Halifax as an entrepôt, and subsidized by the British post office. This line has continued with a regularity and certainty throughout all seasons of the year, more resembling that of a railway than a communication subject to the proverbial vicissitudes of the ocean. It is true that the west coast of Ireland has not been selected as the point of departure for this line; but I am not the less strongly of opinion that, if such had been the case, the certainty and regularity of its arrivals, great as they are, would have been increased.

I have thus stated, as clearly and explicitly as my memory and the memoranda I have preserved enable me to do, all that I have expressed in public on this question. Let me remind you that the efficiency of steam power, more especially as applied to navigation, has been constantly increasing, by the continued application of the resources of engineering ingenuity,

both in the United States and in England. It is well known to every one in this country, that scarcely a month has passed for several years in which some improvements, of greater or less practical importance, are not effected. My opinions, therefore, whatever they might be, *founded on the actual state of steam power in* 1835 *or* 1836, would necessarily require modification when applied to performances in subsequent years. And, finally, let me observe, that even supposing I had made an erroneous estimate of the capabilities of steam power, I should have erred in good company. When it was proposed in England to establish steam vessels to carry the mails between London and Holyhead, the project was literally scouted, not only by men of science in Great Britain, but without any exception, that I know of, by engineers themselves, and above all by nautical men. In the early part of this century, James Watt, to whom the world owes in so great a degree the present advantages of steam power, on the occasion of inspecting the Cornish engines erected under his own superintendence, declared (and the declaration was recorded) that their efficiency could no farther go, that his steam engine had attained the limit of its perfection. Yet within a few years of the date of this declaration, and before that great man was called to a better world, his own steam engines, working at the same places in Cornwall, without any signal improvements in their principle, but by merely carrying into more complete practical effect those powers which his own genius conferred upon them, more than doubled their efficiency; and that efficiency is since increased in more than a four-fold proportion.

The Bristol speech, or lecture, by whichever name it may be called, in which I have been charged with propounding the absurd proposition that it was physically impossible to cross the Atlantic by steam power, was reported in the London Times newspaper, a special reporter having been sent to Bristol by that journal. In this report, which, though unavoidably much abridged, was in the main correct, no such assertion will be found; but, on the contrary, by referring to that journal, it will be found that I stated my opinion that the voyage was quite practicable, and that my only anxiety was to see it established

in such a manner as would insure its profitable and therefore permanent establishment.

I ought not, perhaps, to conclude this letter without some apology for its egotism. Let it however be remembered, that the request you have made is one having a reference so exclusively personal, that the subject of my answer could hardly be free from this disagreeable appearance.

I remain, Dear Sir, yours very truly.

DIONYSIUS LARDNER.

In reference to this letter, it may be observed, that what Dr. Lardner has been called upon to do, viz. to prove a negative, is always a difficult matter. Dr. Lardner has been charged with having made certain assertions, and he is called on to demonstrate that he did not make them. There is only one way of establishing a negative proposition, which is, to prove the truth of the affirmative, its logical contradictory. Dr. Lardner has accordingly taken this method. To prove that he *did not* use the language attributed to him, he demonstrates that he *did say* something which is the logical contradictory of that with which he is charged. He is charged with declaring it to be physically impossible to cross the Atlantic by steam power; and he demonstrates that from the earliest discussions of that project he was its zealous advocate, constantly asserting its practicability, and urging its advantages.

That the proof may not rest upon the unsupported assertion of Dr. Lardner himself, we have referred to the English journals of 1835 and 1836, in which his speeches and lectures have been noticed and reported, and we find them to be in complete accordance with the statements contained in the above letter. As the alledged declaration of the impossibility of crossing the Atlantic by steam was said to be made in the speech which he delivered at Bristol in 1835, we shall here subjoin an extract of the report of that speech, taken from the London Times newspaper, of the 27th of August, 1836, the day but one after the speech was spoken. It is scarcely necessary to add that the Times has the highest reputation of any of the English papers for the correctness of its reports of public speeches.

Bristol, Thursday, August 25th.

SECTION OF MECHANICAL SCIENCE.

DAVIES GILBERT, *Vice President of the Royal Society, in the Chair.*

Dr. Lardner said, that he could not open the important business which had been appointed for this day, without expressing his regret, that important as it unquestionably was, and involving as it did, the interests of large branches of commerce, it should have interfered with another inquiry, which if less attractive for the moment, was in no respect inferior in its ultimate value. The very circumstance of the present and pressing interest which was felt upon this subject—the fact, that already considerable investment of capital had been made in such speculations, was a circumstance which would somewhat embarrass them in arriving at a safe and certain conclusion, because it would be obvious that it would more or less engender in the minds of a considerable portion prejudices which would be liable to bias them. He would therefore beg of every one, and more especially of those who had a direct interest in the inquiry, to dismiss from their minds all previously formed judgment about it; and more especially upon this question, to be guarded against conclusions of mere theory; for if there was one point in practice of a commercial nature which more than another required to be founded on experience, it was this—one of extending steam navigation to voyages of extraordinary length. He was aware, that since the question had arisen in that city, it had been stated that his own opinion was adverse to it. That impression was totally wrong. But he did feel, that as steps had been taken to try this experiment, great caution should be used in the adoption of the means of carrying it into effect. Much would depend on a first attempt, for a failure would greatly retard the ultimate consummation of their wishes. He believed that those in the section who knew him, would readily acquit him of being forward to question the power of steam. He tendered the most unqualified allegiance to the sovereignty of steam; but he tendered the allegiance of a free and thinking subject to a constitutional monarch. He did not bow before the power of steam as an abject slave; and if he found a failure in the administration of that power, he would attribute it entirely to its ministers.—(Cheers.)

The report then goes on to represent Dr. L. as giving the calculations of the performances of the Admiralty steamers, as recommending the west coast of Ireland as the point of departure, and Halifax as an intermediate station. The report of his speech concludes as follows:—

He would therefore counsel those who proposed to invest capital in this most interesting interprise, to keep in mind certain points, to which he would direct their attention. First, he would advise, that the measured tonnage should correspond with the tonnage by displacement. Second, to go to an increased expense in using the best coals. Third, to adopt the split paddles. Fourth, he advised the proportions of at least one horse power to four tons. Fifth, a careful selection of engi-.

neers and stokers, and that the coal-boxes should be tanked.—(Loud cheers.)

Mr. Russel declared that he had listened with the greatest delight to the lucid and logical observations they had just heard, he would merely add one word. Let them try this experiment with a view only to the enterprise itself; but on no account to try any new boilers or other experiments, but to have a combination of the most approved plans which had yet been adopted.—(Cheers.)

Mr. Brunel imputed some errors to the calculations of Dr. Lardner, the correction of which would render them more favorable to the undertaking.

Dr. Lardner in reply, stated, that he considered the voyage practicable; but he wished to point out that which would remove the possibility of a doubt. Because, if the first attempt failed, it would cast a damp upon the enterprise, and probably prevent a repetition of the attempt.

This discussion has created the greatest possible interest.

It appears, then, that this celebrated declaration, which has been circulated so widely, and credited so generally, is, after all, no more than a reproduction of Sterne's story of the three black crows. Dr. Lardner said, that in so novel a project as the establishment of a line of steamers across the Atlantic, it would be unadvisable, in the first instance at least, to attempt an unbroken voyage from Bristol to New-York, as it was improbable it could be continued without interruption through all seasons of the year, and as it would be deprived of the support of the British Post Office. Rumor, with her hundred tongues, and her voracity for the marvellous, immediately swelled this into a dogmatical declaration, made *ex cathedrâ* by a Professor of Natural Philosophy, that *the voyage across the Atlantic by steam power was a physical impossibility.*

We trust that these statements will set the matter at rest, and that Dr. Lardner will feel that he is wrong if he supposes that there does not "prevail on this side of the Atlantic a much more active spirit of justice and liberality among the people, and a much more decisive preference of what is true over what is exciting," than in England.

LETTERS TO THE EDITOR RESPECTING THE ENGINES OF THE STEAMSHIP KAMSCHATKA.

New-York, Oct. 29th, 1841.

PROF. J. J. MAPES:

Dear Sir—At a late hour last night I received the October number of the American Repertory, containing a notice of the Kamschatka steamer, prepared with your usual care and accuracy. I cannot, however, but feel that there is an appearance of an intentional omission of the name of the inventor of the half-beam engine, which I am persuaded you did not notice in the statement. The engines of the Kamschatka were arranged on the principles of the half-beam engine of Mr. W. H. Lighthall, who has obtained patents for his invention, after a full investigation of his claim, as I am informed. To speak of this engine, new in its combination, and for the first time set up in the Kamschatka, as having a technical designation as if in common and ordinary use, does not seem to be either correct in itself nor according to usage in such matters. The engines have been always known as "Lighthall's Half-Beam Engine," for the reasons above suggested; and though it may not be material to an engineer whose reputation is so high as that of Mr. Lighthall to have omissions of his name, as connected with his engine, in all cases formally corrected, yet the character of the Repertory renders it important in this instance; and, I am persuaded, I only ask for him an act of justice which you will be most ready to perform.

I am very respectfully yours,

ROBERT SCHUYLER.

Dear Sir—Your October number of the Repertory contains a description of the Half-Beam Engines of the Russian armed steamer Kamschatka, which conveys the erroneous idea that the said description of engines were in general use, without any particular designation or name, and in reference to which no patentee was known.

This error, which under other circumstances would be of little consequence, becomes important when it appears in a work so extensively and usefully disseminated and known as the

Repertory; and I trust as an act of justice, you will in the next number record the following simple facts, viz:

That the engines of the Russian armed steamer Kamschatka, built at N. York, are the Patent Horizontal Half-Beam Engines, of which William A. Lighthall is the sole inventor and patentee. And,

That the right to use the patent for these two engines, and to construct them in this country, were subjects of donation from the patentee.

Your obedient servant,

WM. A. LIGHTHALL, *Engineer.*

APOLLO ASSOCIATION.

Notwithstanding our disbelief in the usefulness of any institution, devoted to the fine arts, not entirely under the control of artists, still we take pleasure in being able to place the merits of such masters as deserve it before our readers, and were we not confined in our space from press of more useful matter, should give a minute criticism on this exhibition. As it is, we must be content with speaking of the principal attraction only.

The gem of this collection is "The Sortie of the Garrison of Gibraltar," by J. Trumbull. This picture is certainly a masterpiece, and may fairly be called the artist's best work. It is bold and fearless in composition, drawing and color, embracing many of those difficulties in arrangement of color which are so seldom overcome by the painter. The whole picture is in a high scale of color, showing all the brilliancy which must necessarily occur from the bursting of bombs, discharge of cannon, &c. without any loss of evenness of tone. The figures are drawn with positive accuracy, with such a choice of lines as to convince the observer that the artist had studied the antique with great care. Our readers will doubtless recollect the fine engraving, by Sharp, from this picture. It is so very superior to any after attempt of Mr. Trumbull, that were it not for his early pictures, it would be difficult to believe him to be the artist.

There are many other good pictures, of which we would like

to say much if our space permitted. Amongst others are the works of G. Stuart, Inman, Frothingham, Page, Huntington, Bennet, Marchant, Cole, Neagle, Leutze, McDougal, Sir G. Kneller, Cruikshanks, and others. On the whole, it is an excellent exhibition, and we are sorry to say, but thinly attended.

ANTHRACITE COALS.

The use of anthracite coals for steam purposes appears to be daily gaining favor with our engineers, and since its introduction on board our river boats, all the supposed objections have proved unimportant. We understand that Mr. Cunningham is now building six small engines, intended to be applied to blowers, for assisting the combustion of hard coals in large steam boats. By having a separate power for the bellows, the fireman can at all times accelerate the production of steam for the use of the large engine, and thus avoid the necessity of long delays.

The advantages of anthracite coals (particularly for war steamers) are many. When the blower is used, the tall smoke pipe becomes unnecessary, and the draught can be controled by simply turning a cock; the small space occupied for stowing fuel, and the inability of an enemy to track the course of a vessel for many miles before her hull is in sight, as is the case where bituminous coals are used, are advantages of too high a class to be overlooked.

The steamship Clarion is moved, as our readers are aware, by the Ericsson Propeller, with an auxiliary power for the blowing apparatus. Since the introduction of this improvement her performances with anthracite coals have been perfectly satisfactory. Her consumption of fuel was found to be 320 lbs. per hour; which is said to be less than the quantity of bituminous coals used by British steamers of only 40 horses power.

PROGRESS OF SCIENCE.

On the employment of Bronze in Modern Times. [From the Moniteur Industriel.]

The works of the Italian artists excited a general feeling of emulation. In all countries bronze soon began to form a prominent feature in the decoration of public buildings, the statues of kings and warriors being transmitted to posterity through its means. Italy erected statues in bronze to the Medicis and the Farnese; Spain to Philip III; Russia to Peter the Great; Sweden to Gustavus Adolphus; and England to Charles II.

There is much to be said relative to the progress of the art which at present occupies our attention, but we do not wish to proceed to too great a length with this notice. We will therefore confine ourselves to tracing its development in France. It was in France, under Louis XIV, that the art of casting in bronze suddenly elevated itself, under the intelligent efforts of the brothers Keller. The principal masterpieces of these two great artists still decorate the royal residences of Versailles and the Tuileries. Balthazar Keller made, in 1699, at a single casting, the equestrian statue of Louis XIV, of which the model was executed by Girardon. This colossal mass was seven metres in height, and weighed only 26,072 kilogrammes. But the art of bronze founding seemed at this epoch to have attained celebrity only that it might make its admirers regret the more the rapidity of its decline. The equestrian statue of Louis XV, cast after the model of Bouchardon, and which was placed some years after in the Place de la Concorde, was also founded at a single casting by Gor. The height of this statue was only 5 metres 40 centimetres, but its weight was 20,370 kilogrammes.

During the revolutionary troubles the manufacture in bronze was limited merely to cannon; but under the empire, bronze was again called upon to take part in the combination of arts which celebrated the triumphs of our arms and the glory of our soldiers. Unfortunately, this fine art had been too long neglected; the process of casting in bronze was no longer practiced by special and experienced artists, and success did not crown the first efforts of the novices. The statue of Desaix was a complete failure; and the column of the Place Vendôme itself is far from being a *chef d'œuvre.* When, in 1817, Lemot was intrusted with the casting of the equestrian statue of Henry IV, which stands at present on the Pont Neuf, he had the precaution to take at Versailles samples of the bronze in the three fine statues of Keller, which have the highest reputation both as regards execution and casting, being of the true green shade, and of admirable proportions.

The following are the results of the analysis of these three specimens:

	No. 1	No. 2	No. 3	Mean
Copper, - -	91.30	91.68	91.22	91.10
Tin, - - -	1.00	2.32	1.78	1.70
Zinc, - - -	6.09	4.93	5.57	5.53
Lead, - - -	1.61	1.07	1.43	1.37
	100.00	100.00	100.00	100.00

Lemot believed himself sufficiently informed by this analysis; but he did not the less encounter serious accidents in the casting of the statue. He wished to avail himself of the furnace which had been constructed to cast the equestrian statue of Louis XV; but this furnace had not been arranged in a manner to produce a draw sufficient for the perfect fusion of the alloy of Keller, in which there entered a proportion of copper much stronger than that of the statue of Louis XV. After several trials he was obliged to modify it; but still the final casting did not succeed perfectly. The body of the king had several inequalities in it, and the lower part of the belly of the horse was spoiled; a large hole formed in it, which it became necessary to stop up; and, finally, they resold more than 14,000 kilogrammes of the oxidized materials.

The casting of bronze, though offering no great difficulties in the manufacture of articles of small dimensions, presents very great ones when it is required in large masses, and in statues of the human form. The constituent metals have no strong affinity to each other; the metals, when fused, have a tendency to separate, according to their specific gravities; and when the least fusible begin to acquire solidity, the others, in a liquid state, ascend until the easy oxidation of a composing part of the alloy leaves ground to apprehend the separation of the metals.

Independently of these difficulties, there are others to be encountered of an equally serious nature, in the calculation of the component parts of the bronze, especially when a given quantity of metal is required; in the preparation of the mould; the construction of the furnace, &c.

These difficulties, and many others that we could enumerate, will explain why so many miscarriages have at different times attended the casting of a large piece of bronze. They enable us to understand why Falconnet passed fifteen years in founding the equestrian statue of Peter the Great, which figures on its immense pedestal of a single stone block at St. Petersburgh; why the Kellers were nine years founding the statue of Louis XIA; why Bouchardon and his successor Pigalle, were seven years founding that of Louis XV, in the Place de la Concorde; why the grand equestrian statues that we have above noticed did not come perfect from their moulds; and lastly, why the statue of Desaix, and we may almost say the column Vendôme, have been failures. Bouchardon had considerable trouble to produce the delicate forms of the horse of his fine equestrian statue of Louis XV, which came badly from the mould in the lower parts; and we have related the difficulties that Lemot and Piggiani encountered in casting the statue of Henry IV, a work which occupied them four years.

We cannot terminate this article better than by recalling the difficulties which were surmounted in the casting of the column of July. In order the better to understand them, as well as the successful innovations introduced by the founder, let us compare this work to that of the column Vendôme, the only monument presenting any analogy to it. In addition to the fact that the column Vendôme has only a coating of bronze, we have to state, that the largest pieces which compose it are only five metres or thereabouts. Each portion of the shaft of the column consists of six pieces; and yet the column Vendôme cost 2,000,000 of francs. The column of July, on the contrary, is entirely composed of

bronze; every portion of the shaft is a single piece; the base of the column is nearly 16 metres, and the capital at its widest part attains the enormous dimension of 26 metres. The column of July cost however only 1,172,000 francs.

The inequality of the thickness of different parts constitutes one of the great difficulties of bronze casting, because the thick parts do not cool as soon as the others; the contraction of the first takes place sooner than that of the last, which tends to produce fissures. We can equally conceive that the contraction of a piece of metal must be greater in proportion to its dimensions; and the necessity of keeping in mind this consideration offers a new difficulty in the manufacture of the mould, which ought to be calculated in relation to the anticipated contraction. It is easy to understand that the least movement in the mould during the operation, would cause much deviation from the required thickness.

The preceding observations are more than sufficient to enable our readers to appreciate the difficulty with which the different pieces of the column of July were cast. As to the statue which surmounts it, we cannot do better than republish an extract from the report made by M. Héricart de Thury to the *Societé d'Encouragement*, in the name of the committee of mechanical arts, on the improvements introduced by M. Soyez in the moulding of statues in bronze:

"This statue, 4 metres 25 centimetres in height, resting on the toe, and inclining very much forward, presented very great difficulties in the moulding, and greater difficulties still in the casting, the solidity of the statue depending, in a great degree, on the extreme lightness of the upper parts, and the weight of the limb on which it rests.

"If the old process had been followed, this statue would, in all probability, have been a failure, or it would have been found necessary to cast it in several pieces; for the upper part, being very thin, must cool immediately, while the lower, cooling much more slowly, would be drawn back upon itself, producing a division at the hips of about 25 millemetres, the metal contracting from 12 to 14 millemetres per metre, so that the statue would have been inevitably destroyed. To obviate the difficulties that the casting of this statue presented, M. Soyez determined to run it with the head downward, and by this means diminish the danger. We say diminish, because by this arrangement the mould must either give way, or the leg break above the ancle. To guard against this latter danger, M. Soyez fixed at each side of the foot a piece of copper, 0m. 65 in width, terminating in a strong head, so as to force the foot to draw back towards the knee; these plates were finally so combined as to have less thickness than the leg. That which had been anticipated happened, the plates of copper forced the foot to follow the movement of the leg. Full success crowned the experiment of this bold and ingenious innovation. The casting of this admirable statue succeeded perfectly in all its details. It is the first time, perhaps, that a figure of any importance has been cast without a defect. The thickness of this statue is from 4 to 5 millemetres in the upper parts, excepting the wings which have only 2 millemetres. The leg having 55 millemetres commencing from the ancle, diminishes progressively in diameter as far as the thigh."

Manufacture of Iron for Railways. [Extracted from a communication to the Railway Magazine.]

The following remarks form part of an article, upon the danger of using iron of an inferior quality for railway purposes:

A considerable portion of the evil arises from the fact, that, with some very few exceptions, neither the directors, nor the engineers of railways, are practically acquainted with the manufacture of iron, and are therefore not aware of the immense difference which exists in the quality. The price of railway axles (in their rough state) varies from £12 per ton to £25 per ton. The price of wrought iron wheels is just double the price of cast iron; in chairs, the price varies as much as forty shillings per ton; and in rails, there is a difference of from thirty to forty shillings per ton between different manufactures; and this too in an article where from the enormous quantity used, the cost of production is calculated by the manufacturer with the greatest nicety. Now whence arises all this difference? Entirely in the quality of the articles themselves, and not in the amount of profit which different manufacturers consider themselves entitled to, nor in the difference in the expense of carriage from different parts of the country. For, by a strange anomaly, the lowest priced articles come from those quarters from whence the carriage is generally the most expensive.

One great evil attendant on the employment of iron of inferior quality, arises from the circumstance, that iron exposed to great and sudden changes of temperature, and to a constant percussive action, is liable to a slow and gradual change, arising from a re-arrangement of the particles among each other. Although this may appear too theoretical for some, it is still capable of proof by direct experiments in particular and extreme cases. The two great distinguishing features of wrought iron are known by the names of "cold short iron," and "red short iron," the former being the toughest when hot, and the latter when cold. The cause of this great difference is still involved in mystery. It has been attributed to a minute quantity of arsenic in the former description of iron, which is not present in the latter. But this may well admit of considerable doubt, for by heating red short iron a few times, and suddenly quenching it with water, or by a longer continued process of heating without this sudden cooling process—as for instance in the case of wrought iron furnace bars—the most fibrous and toughest red short iron becomes converted into the most brittle cold short iron, the fibrous appearance being exchanged for that peculiar crystallized arrangement of the particles, which so distinctly marks the cold short quality. By what process this crystallization takes place is wholly unknown; but many similar facts in natural philosophy would lead us to suppose, that the effects of sudden changes of temperature, under peculiar circumstances, merely cause the particles of matter to approach or recede from each other, to that particular distance which allows of a new arrangement of the atoms among each other. The instantaneous formation of ice, when water is cooled several degrees below the freezing point and a sudden vibration is communicated to it by a blow given to the vessel containing it, is a familiar instance of this kind of effect, arising from a

new polar arrangement among the particles when, by change of temperature or some other cause, they are brought within a particular distance of each other. As regards this crystallization of wrought iron, there are many facts which seem to lead to the conclusion, that iron continually exposed to minute vibrations, slowly changes to that state of crystallization which can be more rapidly affected by the agency of high degrees of temperature; and if this be the case, we have in constant operation, in many instances, a process which is continually tending to weaken the cohesive strength of iron, and which will more readily take place in iron which partakes in any degree of the cold short character. This, I think, will scarcely be doubted, if we may at all draw any analogy with the process of the congelation of water already alluded to. When water has been cooled several degrees below the freezing point, a sudden blow given to the vessel will generally, but not always, cause its instant congelation. But if the smallest possible particle of ice be put into the water, the crystallization of the whole mass will *always* be instantaneous. We may imagine, therefore, if any similarity exists between the two cases, that iron possessing *a tendency* to the cold short quality will, when subject to the constant state of vibration to which it is exposed on railways, more rapidly deteriorate than red short iron, and become more crystalline in its texture, and therefore possess less cohesive strength.

But whatever may be the tendency to deterioration, there is far too little attention paid to procuring, in the first instance, iron which has been manufactured by processes likely to secure an approved quality. I need scarcely say, to those acquainted with the subject, that railway axles cannot be made of faggotted iron (which I consider indispensable for this purpose) for the low price at which they are charged by some manufactures, and therefore inferior materials are always substituted. I shall, however, pass over this, and confine my remaining observations to the manufacture of railway bars and chairs.

The iron masters have for many years been trying to avoid the process of refining the metal which is used for remanufacturing at the forge. As far as mechanical structure, and even chemical examination goes, the process of refining appears merely to reduce the better qualities of pig iron to the same state as the common "white iron" produced by the furnace. But experience proves that the one cannot be substituted for the other without a very great deterioration of quality in the manufactured bars. Many years of continued experiment have fully proved this, and it matters not, that no rational explanation can be given why the one will not answer the purpose of the other. All parties are agreed that "refining" is necessary to produce really good iron, and that no addition to the subsequent operation of "puddling" can compensate for neglecting it. But the saving of expense is considerable by this mode; and hence the Staffordshire iron masters are now very generally adopting the plan of omitting the refining process in the manufacture of rails, to enable them to compete with the Welsh manufacturers, who, it is supposed, can make iron cheaper than their English competitors. The processes which all pig iron ought to undergo, in order to convert it into bars, are, refining, puddling, shingling, rolling, piling, balling, and re-rolling. This makes common, or No. 2

bars, which, when cut up and again heated, are rolled into rails. Now nothing *less* than this process ought ever to be employed for rails, and several manufacturers increase these processes in different ways, some by an additional hammering, and others by an additional heating and rolling, before rolling the iron into rails. But some also there are, who considerably *reduce* these processes in the following manner:—They leave out *both* the refining and the shingling, substituting for the former a trifling addition to the time the metal remains in the puddling furnace, and for the latter, or shingling process, they give the blooms a "nobbling," as it is technically called, which puts the iron into a little better shape for the rolls, but adds nothing to its quality, as when the shingling hammer is used. Some manufacturers still further reduce these operations, by using a portion of No. 1 bars, which have only passed once through the rolls. Now the result of all this is, that the finished rails, instead of being of a tough fibrous texture, are only one remove from cast iron in quality. The bars, if broken, will present a crystalline appearance; and in strength they bear no comparison to iron which has been properly manufactured. This I consider to be a most serious matter. Thousands, nay, tens of thousands of tons of rails have been made, and are now making in this way, and the directors and the engineers are alike ignorant both of the practice and of the very serious results to which it may lead.

There are, however, other causes which deteriorate the quality of iron, not less than deficient processes of manufacture. The minerals of some districts are naturally so weak, that no art or care in the manufacture can render the iron made from them sufficiently strong for any description of railway work. I am unwilling to enter into particular descriptions, which might appear invidious, or which might seem the result of personal interest. Neither of these sentiments, however, influence me, as I have no interest whatever in the question, nor any motive beyond that of making known a matter of what I consider of great public importance.

But if the question of the strength of the minerals, from which the iron has been made, is a matter of importance in the case of rails, where, according to the general plan at present in use, the rails are made so exceeding strong, for the purpose of resisting deflection, that they may be considered comparatively free from the liability to actual fracture, it becomes of double importance, in the case of railway chairs, which are constantly liable to fracture from the very nature of the materials of which they are made, as well as their form and the position they occupy. The very general introduction of the hot blast has tended much to deteriorate the strength of pig iron. I consider cold blast iron ought alone to be used in the manufacture of railway chairs; and not only so, but that the strongest descriptions only of cold blast pig iron, ought to be allowed to enter into their composition. Instead of this being generally the case, the greatest rubbish, provided only that it possesses the general characteristics of iron, is frequently used for this purpose. The very worst description of old iron, so bad as to be unfit for any other purpose, is purchased expressly for mixing with other iron to make railway chairs; and the only wonder is, not that such chairs should frequently break, but that they should ever stand the required strain.

Others there are who mix the pig iron with the commonest description of hot blast iron; and others—and they too among the largest manufacturers—cast the chairs direct from the furnace, instead of making them from pig iron of the second fusion. Now all these practices, while they tend to reduce the cost of the chairs, are, I contend, dangerous in the extreme; and no saving which can be effected by these means ought for a moment to be put in comparison of the danger which must result from the use of inferior iron either in the rails or chairs.

On the Manufacture of Iron. [Extracts from a communication in the "Mining Journal."]

The principal difference between the metal contained in iron ores of various species consists in the metal, when in the shape of good cast iron, being either red-short or cold-short—that is, more brittle when red-hot than when cold, or more brittle when cold than when hot: for the forge purposes, the red-short is the best. The cold-short quality is generally believed to be occasioned by a very minute quantity of phosphorus contained in the iron. By ascertaining this fact respecting ores, if necessary, the difficulty may be greatly obviated by mixing it with ores of the opposite quality, whereby, with proper management, the produce may be neutral. When the metal is intended for forge purposes, and required very tough, it should be ascertained whether the ore contains any manganese, and in what proportion, as nothing tends to render apparently very good iron more brittle than the presence to any amount of this metal. If it exceeds 1 or $1\frac{1}{2}$ per cent, ore perfectly free should be mingled with it in various proportions—somewhere about half and half; nothing is better than either one of the hematites. The quantity of fuel and the quantity of flux required, in proportion to the ore, depends on the character of the ores; all argillaceous ores, which generally contain a little sulphur, should be calcined before they are thrown into the furnace; the general shape of these calciners is that of a lime-kiln. A fire having been made at the bottom, the ironstone and small coal is thrown on in alternate strata, and the whole kindled; it is drawn out as it is thought to be calcined, faster or slower. This process greatly assists the smelting, inasmuch as a great quantity of earthy matter is got rid of, which could not be separated by hand; and also the metal in the ore, if an oxide, is raised to a greater point of oxidation, and reduces more speedily in the furnace. The hematites, being in the state of the highest oxygenation, require not calcining, and if they are used alone, must be fluxed variously, as some contain argillaceous earth, others calcareous, and others' silicious. Also, to obtain the best metal from them, charcoal should be used instead of coke, there being much less earthy matter in it; the earth of the coke is very apt to get into the iron, which renders it impure.

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The pig-iron is first melted in the back fire, which generally occupies about three-quarters of an hour; the man keeps working it about with a bar till it is all melted; and if, when he stirs about the bar and withdraws it, the metal on the point sparkles and scintilates, it is ready; the

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metal should never be let out till this is the case; if the next fire is not ready, the blast should be slackened, so as not to burn the iron, but still to keep it up to the proper pitch. The metal generally requires a little slag more than it produces by itself, and some thinner, as its own is thick and turgid. The cinder from the lower fire is the best, as it is, when liquid, much thinner, and allows the metal to sink after being well worked. In working iron rather inferior in this fire—say, poor bright and low mottled—it may be a great deal improved by throwing in a shovel of broken limestone to each charge. This engages with the earthy impurities, and clears the iron a great deal, though it by no means makes it equal to that produced from better cast-iron. During the operation some of the slag is tapped out by the hole under the fire plate, when it has accumulated to too great a quantity, which is apt to impede the blast.

When the lower fire is ready for receiving the metal, it is tapped from the back, and runs into the bed of the lower one, where it is received on a bed of charcoal dust, and, as it runs, the workman, with a bar, stirs it up; the fire is kept full of charcoal, or of coke, when making coke iron, in which case they generally use some of the small broken charcoal on the floor of the yard. This operation is conducted by the workman continually stirring up the iron, and raising it up to the stream of air—the oxygen of which soon deprives some of the iron of its carbon, which coagulates; and this process of decarbonization proceeds till all the iron is collected into one mass or ball; the small balls, which form at first, are continually raised to the top of the fuel, and then allowed to sink, with its combustion passing slowly before the blast, which generally blows holes through it, and completely frees it from carbon; the operation is considered finished when all the iron is coagulated into one ball and the cinder lies underneath it, which is tapped out as it requires. The charge in a back fire is generally about 3 or 3½ cwt.; this, of course, loses much in the two fires, according to the nature and quality of the iron. The charge, when working on coke iron, is taken out in one lump to be hammered, but when working charcoal, one lump is drawn about three-quarters time, and the rest follow it, as small pieces are better refined in the fire and better hammered, than large ones. The only requisite in hammering is to do it regularly, so that all the stamp may be of the same texture, and also to hammer it thin enough. Coke should never be more than 1½ inch thick, and charcoal not more than one inch. When of these sizes, they heat much more regularly at the hollow fire than when thicker, as, in that case, the outside surfaces are apt to burn before the mass is hot enough to weld well. After being hammered, the stamp is thrown into a large box of water, where a continual stream is running through; this assists the stamp in throwing off the scales of oxided iron formed during the hammering, and what little cinder may still adhere to it. The appearance of a stamp, which has been well worked and properly hammered, is that of large open crystals; if this is intermixed with parts cutting much finer, either towards the edges or in the middle, it is a sure sign of its not having been sufficiently worked, or, what the men term "raw," part of it having escaped the action of the blast, and, therefore, still containing a proportion of carbon and earthy matter. If the men are careless

in working it, the stamp sometimes throws a quantity of dirt in the middle or towards the edges; this must be thrown back by the stamp cutter, as one piece will spoil a whole bar. The stamps are now taken to the hollow fires to be wrought into bars; they are piled on the end of staffs, in three layers; the middle layer here always consists of black plate shearings, bundled, which tends to keep the lump open and more accessible to the heat uniformly; where these cannot be obtained, the best thing is the cuttings off the ends of other bars; it also permits the cinder that may be attached to the surface to run or be blown out from between. The lump should never, when cut off after working, and rolled into a bar, weigh more than 100 lbs. as the men cannot possibly work a heavier piece well. The staff is then entered into the fire, and the heat continued, till it is throughout in a welding state; it should then be drawn under the hammer to weld it firmly; it should, before the heat is off, be hammered on every side, to make it perfectly solid, but the first three or four blows should come on the flat, which renders the middle solid, and drives out any cinder that may be between. As it is impossible to improve the body of a lump after the first or welding heat, great attention should be bestowed on it, that the iron is not burnt in the first place, and that it is not drawn out before it is quite ready in the next. To make the best bars, the iron should not be heated more than twice if possible, as every heating partly undoes what the preceding hammering has done; and the second, and, if required, the third, heat should be as low as possible, for the proper drawing of the bar. The lump should first be drawn into a piece about 3 inches thick, and 3 or $3\frac{1}{2}$ feet long, then cut in the middle, and the end-piece turned upside down, back on the staff piece; this reverses the fibres, and tends to strengthen the iron; and also brings all the waster piece to end. This operation, of course, requires a good welding heat in the second process, but the hammering should be completed in that, the bar drawn to the proper length, and cut off hot enough for the rolls to receive it at once; if it must be heated again for passing it through the rolls, it must also be hammered; sometimes men, if not watched, pass it through without —the almost sure consequence of which is, the bar is spoiled. This process of cutting the lump and doubling it is not always practiced, but where the best and toughest iron is wanted, it should be done. The hamslow, or cinder, driven off with the hammering, is generally preserved for the furnace; when the hearth is at all foul, the addition of a little hamslow will generally work it off, as, being already an oxide of iron, it works much hotter than raw mine. The bars are then sent up to the black plate mill, where they are cut into lengths, according to the sized plates wanted. The pieces are then piled on one another, (about 12 or 14) and placed in the furnace, which is a large reverberatory, having a small fire-place in proportion to the square of the furnace itself. Four or six of these piles are heated at once—the door and the top of the chimney being closed, so that all the heat being retained, the plates get a uniform heating. The rolling of these pieces, which vary according to the plates wanted, from $\frac{3}{8}$ to $\frac{5}{8}$ by 5 inches wide, is called breaking down. They are passed through the rolls a certain number of times, so that they come to nearly the same length, about two feet or so long. These first plates are then thrown, as they are rolled, into the

same furnace again, on one side, upon one another, corresponding to the first pile; and, after all are in, the door is again closed, and they reheated. In breaking down, the pieces should be entered rather corner ways, as, if the whole broadside is entered at once, the jar is likely, if not certain, to break the rolls. The first plates are then again rolled, which brings them about 4½ or 5 feet long; they are thrown over to the doubler, who doubles them up and flattens down the bend with a hammer; they are then thrown to the furnace man, and again heated and rolled. This process is continued according to the plates wanted —sometimes doubled twice, sometimes three times, and four times, which last makes it sixteen thicknesses. The plates, during the last rolling, are measured by a guage which the workman has for the length; he makes them as near to this length as possible, so that two or three, as they are wanted, may come out lengthways. They are then passed on to the shearers, who mark and cut them to the proper size; girls then divide them, and they are sent to the scaling furnace.

Observations on the manufacture of Coal Gas. By Dr. Penot. [Read before the Society of Industry at Mulhausen.]

Of all the methods that have been adopted for procuring artificial light, there is none which produces so brilliant a flame as the burning of bicarburet of hydrogen; therefore the use of gas is now becoming general in all the principal towns of Europe. Yet the manufacture of gas does not appear to have reached the degree of perfection of which it is capable.

Having for some time past made many chemical experiments on this manufacture, I ask permission to submit them to you.

In the first instance I directed my attention to the quantity of water contained in coal when it is distilled, and to the influence this moisture might have over the production of the gas. I took small coal from the boat, just in the state in which it arrived in the basin at Mulhausen, and after having dried it by a moderate application of heat, I discovered that it contained 10 per cent of water. I afterwards moistened another portion of the same coal until it appeared as wet as coal does after having been exposed to the rain for some time, it then contained 21 per cent of water.

I fear this circumstance has not been taken into consideration in the various experiments that have been made on a large scale, either with respect to ascertaining the relative quantity of heat produced by different kinds of coal, or with respect to the advantages to be derived from the new improvement proposed to be made in the apparatus for heating. I do not know if the 21 per cent would be always a maximum; but if it is admitted to be, 100 kilogrammes of coal made as wet as I have stated would in reality contain only 79 kilogrammes of dry coal; and of that quantity, 4 kilogrammes are necessary to evaporate the 21 of water. There are, then, but 75 kilogrammes of such coal in 100 that can be really available. Thus there will be a difference of 25 per cent. I certainly do not think that coals so wet as those I have mentioned have ever been used, particularly not in experiments; but I much fear that

for want of drying the coal mistakes may have been made amounting perhaps to 10 or 12 per cent. This observation renders us aware how great would be the advantage of keeping coal under cover. By that means it becomes dry, and is not liable to the deterioration that some coals are subjected to when exposed to the alternations of dry and wet weather.

I return to the preparation of gas for lighting. I have distilled the coal containing 10 per cent of water till entirely exhausted. This gas, after having been purified in the usual way, was conveyed to gasometers, each containing five litres, from whence it was immediately put into a gas vessel with a stopcock, to be ready for burning. By means of this preparation, the quantity of the gases at the different stages of the distillation could be judged of. I have obtained from 1 kilogramme of this coal:

Gas of good quality, producing a clear and brilliant flame,	160 lit.
Gas of bad quality, producing a red flame, without brightness,	92
	252 lit.

Of this, only 160 could have been employed for lighting; so that the distillation should have been stopped before they were produced. I think that in every gas manufactory practice should have taught them the most favorable time for recharging the retorts. I obtained as a residue from this operation 632 grammes of coke. After having dried the same coal, I obtained from each kilogramme:

Gas of good quality - - - - - - - - - -	240 lit.
Gas of bad quality - - - - - - - - - -	92
	332 lit.

Therefore it is perceived that coal containing 10 per cent of water produced only 160 litres, or 4.67 cubic feet of gas of good quality, the kilogramme; and that the same quantity of coal dried produced 240 litres, or 7 cubic feet, precisely half more. I have obtained by this operation 668 grammes of coke, a rather smaller proportion than was obtained with the wet coal, if the quantity of the distilled coal is alone taken into consideration. In fact, the quantity of coke will be less, if the proportion of gas extracted is greater. Finally, the process of distillation was shorter with the dry coal than with the other, so that there will be an economy of time as well as of fuel by using it when previously dried.

The very great difference that I have found between the produce of dry coal and coal that has been wet may in my opinion be attributed to there being, at the commencement of the operation, a great part of the heat employed in evaporating the water. The temperature of the retort is then not so high, and a considerable quantity of bitumen is distilled without being decomposed. I have remarked, also, that in this case a longer time elapses before any great quantity of the gas comes over, and have already stated that the whole of the operation was longer. Perhaps the difference would not exist in the same degree when carried on on a large scale, when the retorts are refilled while they continue hot; but I am convinced a very decided advantage would be the consequence of drying the coal before it is used. Besides, nothing could

be easier than to effect this without expense, since nothing more would be required than to spread, before the furnaces, the coal that would be wanted on the ensuing day.

To obtain a large volume of gas is not all that is required; regard must also be paid to its quality. It is not, in fact, to receive a determinate quantity of bicarburet of hydrogen that consumers require; but to be able to procure as great a volume of light as they want. It is to effect this that every one, more or less, opens the stopcocks of his gas burners, in order to obtain an equal proportion of light. Thus what is wanting in quality is supplied by additional volume. Gas manufacturers would then be mistaken if they calculated only on the quantity daily produced. It is requisite to take into consideration also the quantity of light which it will produce in comparison with that of lamps.

On some supposed Forms of Lightning. By MICHAEL FARADAY, D.C.L., F.R.S. (Selected from the Philosophical Magazine and Journal.]

The magnificent display of lightning which we had on the evening of the 27th of last month, and its peculiar appearance to crowds of observers at London, with the consequent impressions on their minds, induces me to trouble you with a brief letter on certain supposed appearances and forms of lightning, respecting which the judgment of even good observers is often in error.

When, after a serene sky, or one that is not overcast, thunder-clouds form in the distance, the observer sees the clouds and the illumination of the lightning displayed before him as a magnificent picture; and what he often takes to be forked lightning, (i. e. the actual flash, and not a reflection of it,) appears to run through the clouds in the most beautiful manner. This was the case on that evening to those who, being in London, observed the storm in the west, about nine o'clock, when the clouds were at a distance of twenty miles or more; and I have very frequently observed the same effect from our southern coasts over the sea. In many of these cases, that which is thought to be the electric discharge is only the illuminated edge of a cloud, beyond and behind which the real discharge occurs. It is in its nature like the bright enlightened edge which a dark well-defined cloud often presents when between the sun and the observer; and even the moon also frequently produces similar appearances. In the case of its production by lightning and distant clouds, the line is so bright by comparison with the previous state of the clouds and sky, so sudden and brief in its existence, so perfectly defined, and of such a form, as to lead every one at the first moment to think it is the lightning itself which appears.

But the forms which this line assumes, being dependent on the forms of the clouds, vary much, and have led to many mistakes about the shape of the lightning flash. Often, when the lightning is supposed to be seen darting from one cloud to another, it is only this illuminated edge which the observer sees. On other occasions, when he was sure he saw it ascend, it was simply this line more brilliant at its upper than at its lower part. Some writers have described curved flashes of lightning, the electric fluid having parted from the clouds, gone obliquely

downwards to the sea, and then turned upwards to the clouds again: this effect I have occasionally seen, and have always found it to be merely the illuminated edge of a cloud.

I have seen cases of this kind in which the flash appeared to divide in its course, one stream separating into two; and when flashes seen at a distance are supposed to exhibit this rare condition, it is very important the observer should be aware of this very probable cause of deception.

I have also frequently seen, and others with me, a flash having an apparently sensible duration, as if it were a momentary stream, rather than that sudden, brief flash which the electric spark always presents, whose duration even Wheatstone could not appreciate. This I attribute to two or three flashes occurring very suddenly in succession at the same place, or nearly so, and illuminating the same edge of a clond.

The effect I have described can frequently be easily traced to its cause, and when thus traced best prepares the mind to appreciate the mistakes it may lead, and has led, to in the character, shape and condition of the lightning flash. It often happens at the sea-side, that, after a fine day, clouds will toward evening collect over the sea on the horizon, and lightning will flash about and amongst them, recurring at intervals as short as two or three seconds, for an hour or more together. At such times the observer may think he sees the lightning of a flash; but if he waits till the next illumination, or some future one, takes place, he will perceive that the flash appears a second time in the same place, and with the same form; or perhaps it has traveled a little distance to the left or right, and yet has the same form as before. Sometimes an apparent flash, having the same shape, has occurred three or four times in succession; and sometimes it has happened that a certain shaped flash having appeared in a certain place, other flashes have appeared in other places, then the first has reappeared in its place, and even the others again in their places. Now in all these cases it was simply the illuminated edges of clouds that were seen, and not the real flashes of lightning. These forms frequently appear to be in the cloud, and yet are not distinguishable till the lightning occurs. It is easy, however, to understand why they are then only developed, for that which appears in the distance to be one dull mass of cloud, distinguishable in figure only at its principal outline, often consists of many subordinate and well-shaped masses, which, when the lightning occurs amongst or beyond them, present forms and lines before unperceived.

The apparent duration, which I before spoke of, is merely a case of very rapid recurrence, and may, by a careful observer, be easily connected with that which I have now proposed as the best test of the nature of the phenomenon.

There are some other circumstances which will help to distinguish the effect I have thus endeavored to describe from the true appearance of the lightning flash, as the apparent thickness, sometimes, of the supposed flash, and its degree of illumination; but I have, I think, said enough to call attention to the point; and, considering how often the philosopher is, in respect to the character of these appearances, obliged to depend upon the report of casual observers, the tendency of whose minds is generally rather to give way to their surprise than to simplify what may seem remarkable, I hope I have not said too much.

On the circumstances under which the Explosions of Steam-Boilers generally occur, and on the means of preventing them. By Dr. SCHAFHAEUTL, of Munich, Assoc. Inst. C. E. [From the Mechanics' Magazine.]

In this communication it is assumed, that, perhaps not one-tenth of the recorded explosions of steam-boilers can be correctly attributed to the overloading of the safety valve, or to the accumulation of too great a pressure of steam in the boiler. The author alludes to the degree of pressure which hollow vessels, even of glass, are capable of sustaining, if the pressure be applied gradually. He found, in repeating the experiments of Cagniard de la Tour, subjecting glass tubes of one or two inches in length, one fourth-part filled with water, hermetically sealed, and immersed in a bath of melted zinc, that they apparently sustained the immense pressure of 400 atmospheres without bursting; but if the end of an iron rod was slightly pressed against the extremity of the tube, and the rod caused to vibrate longitudinally, by rubbing it with a leather glove covered with resin, the tube was invariably shattered to pieces.

Hence he concludes, that something more than the simple excess of pressure of steam in the boiler is necessary to cause an explosion; and that a slight vibratory motion alone, communicated suddenly, or at intervals, to the boiler itself, might cause an explosion. From the circumstance of safety valves having been generally found inefficient, he concludes that a force has operated at the instant it was generated in tearing the bottom or sides of the boiler, before it could act upon the safety valve.

From the sudden effect of this force, explosions have been ascribed to the presence of hydrogen, generated by the decomposition of water but, independently of the difficulty of generating a large quantity of hydrogen in such a manner, it could neither burn nor explode without the presence of a certain quantity of free oxygen, or atmospheric air; and such an explosive mixture would not take fire, even if mixed with 0·7 of its own volume of steam.*

The ordinary mode of converting water into steam is by successively adding small portions of caloric to a relatively large body of liquid; but if the operation was reversed, and all the heat imparted to a given quantity of water in one unit of time, an explosive force would be developed at the same moment. For example, if a bar of iron be heated until it is coated with liquid slag, and is then laid upon a globule of water on an anvil, and struck with a hammer, the liquid slag communicates its caloric instantly to the water, becoming solid at the same time that the water is converted into vapor with a loud report. A similar occurrence may take place in a steam boiler when a quantity of water is thrown into contact with an overheated plate, either by a motion of the vessel, or from a portion of the incrustation formed on the bottom or sides becoming loosened. A sudden opening of the safety valve may, under certain circumstances, prove dangerous, or even any rapid increase of heat which would cause a violent excess of ebullition in the water.

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* See the author's experiments, Mech. Mag. vol. xxx., p. 144.

An examination is then entered into of the respective powers of water and of steam, to transmit undulatory motion, and of their compressibility. According to Laplace, the conducting power of steam at four atmospheres, and 294·1° Far., is 1041·34511 per second, and that of water 6036·88 feet. The ratio of these different velocities is, therefore, as 1 : 4·5.

In cases of a sudden explosive development of steam, the principal action is directed against the bottom or the sides of the boiler, whence spreading itself through the water, it is finally transmitted through the steam to the safety valve : a wave created by an explosion, even at the surface of the water, would reach the bottom or the sides of the boiler, 4½ times sooner than it would affect the top of the steam chamber ; but if it took place at the bottom, the time for the explosive wave to reach the safety valve would be the sum instead of the difference of both velocities. Although these relative periods of time may be considered as infinitely small, it is contended that there is sufficient delay (counting from the moment at which the plates begin to yield) to cause the rupture of the material which would otherwise have yielded by its own elasticity, had the time been greater, as all communication of motion is dependant only on time.

To illustrate the effect of the sudden development of an explosive force upon the plates of a boiler, the author gives the result of a series of experiments made by him upon iron wires, for the purpose of ascertaining the amount of elongation which took place before yielding under the sudden application of a given weight. The result was, that a wire which had resisted a tension of 22 cwt., when gradually applied, broke invariably, without any elongation, when the same force was suddenly applied by a falling body.

Similar experiments with railway bars showed that fibrous iron, which supported a gradual tension, broke by the sudden application of the same force ; while close-grained iron, which was incapable of resisting the gradual strain, bore perfectly well that of sudden impact. These facts are worthy of consideration in the selection of iron for boiler plates, where the sudden action of the rending force is to be guarded against.

The details are then given of a series of experiments, illustrating in an ingenious model, by means of an explosive mixture of chlorate of potass, the effects of explosions of different heights within a boiler.

A careful examination of the circumstances, and the results of his experiments, convinced the author that a simple mechanical arrangement, applicable to all boilers, might be introduced, so as to diminish the danger arising from the sudden development of an explosive force. He proposes to connect with the bottom of the boiler, by means of a pipe, an extra safety valve of a given area, loaded to five-sixths of the absolute cohesive force of the boiler plate. In the event of a sudden development of steam, the first shock would act upon the valve, and open it, which would have the effect of depriving the wave generated of its destructive force, and at the same time diminish the violence of the second shock from the top of the boiler, having permitted the escape of a portion of the water from the boiler.

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The apparatus for conducting the experiments was presented with the communication.

Mr. Parkes stated, that he had been occupied for several years in collecting facts illustrative of the phenomena of steam boiler explosions. These disasters could not all be referred to one cause. A boiler might be too weak to sustain the pressure within it, and a rupture would be the necessary consequence. But though the simple elastic force of the steam might thus occasionally account for the rending of a boiler, that cause was insufficient to explain many well-known phenomena, such as the projection of an entire boiler from its seat, the separation of a boiler into two parts, the one remaining quiescent, the other being driven to a great distance, &c. He was of opinion that a very sudden development of force could alone have produced such effects.

Dr. Schafhaeutl had ingeniously shown that an explosive force generated under water would act upon the bottom of the boiler and burst it, before the safety valve could relieve the pressure. The Doctor deduced from Mr. Parkes' theory of the "Percussive Action of Steam," and his own experiments, that if, from any cause, such as the breaking up of a portion of crust adhering to the bottom of the boiler, a volume of steam of high elastic force was suddenly evolved, a rupture of the bottom would be the consequence, or, the boiler might be separated into two parts. Mr. Parkes coincided in this opinion, and cited several examples in support of it.

It appeared to him that a force different from, and greater than, the the simple pressure of the steam, was the principal agent. The committee of the Franklin Institute, and others, who in their experiments had endeavored to produce explosions of boilers, had very rarely succeeded, and the effects obtained fell far short of those which continually occurred by accident. It might be safely inferred from this fact, that the experimenters had not arrived at the true cause of the ruptures and projections of boilers, otherwise the production of similar effects would not have been difficult.

Describing the sudden development of a volume of steam, from highly heated plates, which no practicable number of safety valves could discharge quickly enough to save a boiler from destruction, he instanced the effects produced by the breaking up of the scale in salt pans. Carbonate and sulphate of lime were separated from brine by evaporation, and adhered very firmly to heated surfaces. A crust of salt frequently formed upon this deposit, the cessation of ebullition (if the deposit occurred over the furnace) was the consequence, and the bottom of the pan became red hot. The manner in which the pan scale was disengaged, was to strike it with the edge of a heavy iron pricker, which allowed the brine to reach the plate; it was also frequently broken through by the expansion and bagging down of the plates, leaving the crust above like an arch. In such cases the plate was seen for an instant to be red hot, and immediately afterwards an immense column of brine was projected from the pan, the steam evidently being of a high momentary elasticity. Mr. Parkes had seen a yard square of scale thus burst, the whole surface of the plate being at a glowing red heat. Had the pan been closed

like a steam boiler, he conceived that the blow of the steam on the roof, bottom, or sides, would have destroyed the vessel.

A thin copper salt pan at Mr. Parkes's works had a hole burst through its bottom by the sudden action of steam thus generated. The spot had no doubt been previously injured by heat. He conceived that similar phenomena might, and frequently did occur in steam boilers.

A theory had been adopted by many writers on the explosion of steam boilers, that red hot iron plates would generate less steam than plates at a less heat. This was founded on the experiments of Leidenfrost, Klaproth, and others, on the length of time requisite to evaporate a small globule of water in a red hot spoon. But there was no analogy between the condition of a hot spoon containing a drop of water, and that of a body of water and heated plates in boilers.

Steam of great force would instantly be produced from a thin sheet or wave of water passing over hot plates, the molecular attraction of a drop falling a short distance upon a plate would be destroyed, and the whole be instantly converted into steam of a high momentary elasticity. The theory of the hot spoon experiment, as applied to boilers, had been demonstrated to be fallacious by Dr. Schafhaeutl, in a paper published in the Mech. Mag. vol. xxx., No. 799.

The explosion of several boilers had been attributed, and Mr. Parkes thought justly, to a wave of water washing over highly heated plates. He believed that the fatal accident to the "Union" steamer at Hull was so produced. The boilers of steam vessels were not at that period so well arranged as at present, for preventing the water from flowing to one side, and leaving a portion of the top of the flues dry with the fire beneath. Under such circumstances, the disaster which occurred would be inevitable, on the vessel's coming on an even keel. Mr. Parkes was not of opinion that it required the exposure of a large area of heated metal to effect the separation of a boiler and the projection of the upper half of it; as, in this case, it was the suddenness of the action, no number of safety valves could have deprived the steam of its instantaneous force, so as to have saved the boiler. The entire circumference of large boilers had been frequently divided as clean as a pair of shears would have accomplished the work. These phenomena were evidences of a force very suddenly exerted.

Sudden actions on the surfaces of boilers arose also from other causes than the heating of plates. During the inquiry into the causes of steam vessel accidents, he ascertained that of twenty-three explosions, nineteen occurred on the instant of starting the engines, or whilst the vessels were stationary; three only whilst the engines were at work; the greatest number took place at the moment of admitting the steam upon the piston. He attributed this effect to the steam's percussive force, which would be as much felt by the boiler as by the piston; if the boiler was weak, and distended by steam to nearly the bursting point, the shock would be sufficient to cause its rupture. Mr. Parkes then gave several instances of such occurrences.

In 1817, the boiler of a steam vessel at Norwich burst, and killed many persons. Previous to the accident, the boiler leaked in several places; the steam issued copiously from the safety valve, which was evidently very heavily loaded. The engine had scarcely made a revo-

lution before the explosion occurred. By applying the present state of our knowledge to these facts, he felt assured that the steam's impact on the piston had been the immediate cause of that accident.

In 1826, or 1827, Mr. Parkes witnessed the effects of an explosion, a few minutes after its occurrence, in the neighborhood of his works, near Paris. The boiler was of wrought-iron, 6 feet long, by about 2 feet 6 inches or 3 feet diameter. By his advice, the owner had previously put in a new end, formed of one piece of hammered iron, and he was strongly dissuaded from overloading his engine, or using habitually such enormous pressures. The cylinder of the engine was horizontal, and was connected with the boiler by a short pipe and cock. The proprietor informed him, that finding his machinery working too slowly, he went into the engine house and stopped the engine. He held down the lever of the safety valve, and on turning the cock to start the engine, the explosion instantly occurred. The new end of the boiler, which was opposite to the engine, was found separated from the body, and lying in the flue. The line of rivets, and a complete ring of the new end, remained upon the body, apparently little forced, and the faces of the fractured ends were as sharp and clean as if cut by a chisel or shears. The boiler, engine, and masonry were driven into the yard in the opposite direction to the escape of the water and steam; thus, though the entire end of the boiler was removed, and the whole contents evacuated, it acted too late as a safety valve.

He observed similar effects last year, in an explosion at Camden-town, being fortunately on the ground to investigate it before much change had been made. Two boilers were set end to end, with a chimney between them. The end of one was blown out, and was lying close to its original seat. It was forced backwards into the chimney, which it partly supported on a pipe flange, and pushed the other boiler and entire masonry, in a horizontal direction, fully two feet. He considered that the percussion of the steam, from its reaction against the opposite ends of the boiler, in the act of tearing it off, (which was the effect in this case,) produced the recoil. In this case there were upon the boilers, (which were connected together,) two safety valves in good order, and not heavily loaded. The accident occurred during the breakfast hour, whilst the engines were not at work. One of the two stays which originally held the fractured end of the boiler was found to have been previously broken, as its separated ends were covered with old lime scale—the other had evidently been long cracked, and was only held by a fragment. The fractured end of the boiler was not exposed to the fire, nor did the shell or the flue within it exhibit any marks of injury from fire, or from dislodgement of scale. The steam, in its effort to escape, acting first against one end, not only raised the boiler from its horizontal position to an angle of about 45°, but gave it a twist obliquely from the line of its bed.

Mr. Parkes could not agree in the often expressed opinion, that what are called high pressure steam boilers were more dangerous, or more liable to explode than others. Much depended on care and management. He believed that he was in possession of accounts of nearly all the explosions which had occurred in Cornwall since the expiration of Mr. Watt's patent, when higher pressures began to be used, and they

amounted only to five or six instances, exclusive of some cases of collapsed flues. More explosions had occurred in a small district round Wednesbury, during the present year, with low pressure boilers, than in Cornwall in forty years, where the highest pressures were employed. He believed also that the coal districts of Northumberland, Durham, and Staffordshire, would furnish more cases of these disasters, from boilers both of high and low pressure, than all the rest of England put together.

When the practice in the coal districts was contrasted with that of Cornwall, the explanation was simple. Where coal was so cheap, the quantity used was unlimited, the negligence was great, and the allowance of boiler was small for any given sized engine, as enough steam could be raised by fires of greater intensity—the rule there being, to save in the first cost of the boiler; in Cornwall, on the contrary, the object was to insure economy in the consumption of fuel; consequently, all that class of accidents arising from injury to plates by fire and deposit, would be in about the ratio of the intensity of the combustion.

Notwithstanding the bad practice generally prevailing in the coal districts, there were some exceptions. At an iron work near Dudley, there were boilers now in good order, after nearly thirty years' use, having required but trifling repairs during that period. In those boilers, the plates of the bottoms which were exposed to the fire were all made of hammered, not of rolled iron—the boilers were large for their work, and were cleaned thoroughly every week.

Tilted plates were alone used for salt pans in those parts where the heat was most intense. Though continually heated to redness, and distorted by the action of the fire, the quality of the iron in plates thus formed did not appear to be deteriorated, for when taken out, the smiths used them for making rivets, nails, &c. Rolled iron plates would do for making coarse salt, which required a heat below ebullition, but they were quickly injured when used for fine salt, and were useless when taken out.

Mr. Parkes then adverted to several other remarkable cases of explosion. It was a well-authenticated fact, that a boiler belonging to Messrs. Ferey, at Essonne, in France, exploded on the instant of opening the safety valve.

Three successive reports were heard when Steele's steam boat boilers exploded at Lyons, indicating that they did not burst at the same instant. Now, though Mr. Steele had fastened down the safety valve to increase the pressure of the steam, yet the explosion of the first boiler should, according to the received opinions, have acted as a safety valve to the second and third, and have saved them—for, by the destruction of the first boiler, the pipes would be broken, and a free exit be afforded for the steam in the others; nevertheless, they all three burst in succession. Several similar instances of successive explosions had occurred in England. He would not at present enter upon an explanation of what he considered might occasion these phenomena; but he would express his conviction, that the practice of suddenly opening and closing the safety valves was extremely dangerous. To be useful as escape valves, they should be allowed to open and close in obedience to the steam's pressure only, not to be handled more than was absolutely necessary.

None of the theories yet advanced appeared clearly explanatory of the cause of the projection of heavy boilers from their seats, when in many cases they contained abundance of water. He instanced a case in which a boiler exploded, and carried to some distance a boiler connected with it, and in which some men were at work. The boilers separated while in the air, and the one which exploded attained a very considerable height, although it was 28 feet long by 6 feet diameter. The particulars of this explosion were furnished to him by Mr. Clarke, engineer to the Earl of Durham, but they could not be properly appreciated or explained without the drawings and description.

A boiler weighing about 2½ tons was projected from its seat at Messrs. Henderson's woolen factory, at Durham, in 1835; it ascended to a considerable height, and fell 300 yards from the place where it had been seated.

A cylindrical boiler exploded at the Crenver Mine, in Cornwall, in 1812. It passed through the boiler house, and opened itself in the yard outside, where it was described to have fallen "as flat as a piece of paper."

Facts of this nature were replete with interest, and should lead engineers to the consideration of causes and remedies.

Mr. Parkes then instanced several cases of boilers which had become red hot, and had not exploded; one example was a set of three boilers, the tops as well as the bottoms of which were red hot, in consequence of the house in which they were fixed being on fire; yet they did not explode. No water had, however, been pumped into the boilers whilst so heated.

He was in possession also of several curious examples of ruptures and projections of vessels arising from causes very different to the foregoing. One case occurred in February, 1837, at the works of Messrs. Samuel Stocks snd Son, in the township of Heaton Norris, near Manchester. The boiler was 20 feet long, 9 feet wide, and 10 feet deep, and weighed about 8 tons. On a Saturday night the water was blown out of it through the plug-hole at the bottom, by the pressure of the steam, the man lid not being removed. On Sunday evening the fireman proceeded to take off the man hole cover to clean the boiler; on entering it with a candle and lantern, a violent explosion occurred; and the man was projected to some distance and killed. On examining the boiler, it was found quite dry, no fire being alight, no traces of water near it, and it was quite cold: it had been lifted from its seat up to the roof, which it destroyed, and the walls of the building were thrown down. There was no difficulty in accounting for the presence of a combustible gas, as hydrogen might be evolved from the decomposition of the steam (which would remain in the boiler after the expulsion of the water) by the heated sides and bed of the boiler, and the atmospheric air which entered through the plug hole or through the man hole, when the lid was removed was sufficient to form an explosive mixture. The projection of the man was the simple effect of firing the gas; but to account for the entire boiler being carried from its seat, was more difficult. The figure of the boiler after explosion, exhibited two distinct actions; the ends and sides had evidently been bulged outwards

by the force of the explosion within it, and the bottom had been crushed upwards by the force which raised it from its seat.

Mr. Parkes thought the circumstances admitted of a satisfactory explanation, but would not then enter upon it, as it involved the history and phenomena of projections of vessels from their beds with a vacuum within them, which he thought would be better understood after the reading of his paper on the "Percussive Force of Steam and other Aeriform Fluids," then in preparation for the Institution.

The foregoing case of the formation of hydrogen gas in a boiler, after all the water had been evacuated, was confirmed by one which took place in a similar manner at the sugarhouse of Messrs. Rhodes and Son, in London, of which all the particulars had been furnished to him by Mr. Henrickson, the manager. A man entering the boiler with a candle and lantern to clean it, was projected to a great height. No rupture of the boiler took place, as the quantity of hydrogen seemed to be comparatively small, and to be confined to the upper portion of the boiler; but a series of detonations occurred, like successive discharges of cannon.

These two remarkable instances showed the importance of attending to minute circumstances in the management of boilers. The practice of completely blowing out boilers whilst the flues were intensely heated, was evidently dangerous, nor should it be done without removing the man hole cover.

Mr. Parkes felt that these notices of explosions were very imperfect without drawings, and reference to documentary evidence; but as the subject had been brought before the Institution by Dr. Schafhaeutl, he hoped they would be received as contributions to the stock of knowledge, and as illustrative of the precautions to be observed by attendants on steam engines.

Mr. Seaward was glad to find the idea of the explosions of boilers arising from the formation of hydrogen gas, so successfully combated by Dr. Schafhaeutl and Mr. Parkes. He perfectly agreed with the former in his opinion of the causes of the majority of explosions. In all that he had witnessed the effects of, the lower part of the boiler appeared to have suffered most.

He was at the Polgooth Mine immediately after the explosion there, when 17 persons were killed. In that case, he was told that the boilers were moved a distance of seven or eight feet from their seats, before any detonation was heard.

At the Hurlam mine (which Trevithick had undertaken to drain for a certain sum) an engine with a cylinder of 40 inches diameter was erected immediately over the shaft. Its power was not sufficient for the work required; the pressure of steam was therefore gradually increased as the depth became greater. At length the boiler, which was of an immense length, was observed to have a constant tremulous or sinuous motion at each stroke of the engine, and eventually it exploded.

It appeared that there were fewer explosions of boilers in London, in proportion to the number employed, than in any other district. One reason for this might be, that fuel being expensive, it was used economically, by maintaining a slow rate of combustion, and a regular supply

of steam, avoiding the intense action of the fire, which, in the event of the engine standing still for a time, had a tendency to produce an explosion.

Mr. Parkes attributed the small number of explosions of boilers in vessels on the Thames, to the practice of allowing the steam to act upon the safety valve, instead of the engineer lifting it when the engine was stopped, as on board vessels in the north. The sudden closing of the valve had in many cases produced an explosion. While on this subject, he felt it necessary to comment upon what he considered fallacious reasoning of Tredgold on the formation of hydrogen gas in boilers.* The passage he alluded to was couched thus:—"Hydrogen gas may be, and frequently is, formed in steam boilers through the water being in contact with a part of the boiler which is red hot; and it seems to be regularly produced during the formation of steam at very high temperature." Dr. Schafhaeutl had shown, that the effect of water coming suddenly in contact with a part of the boiler which was red hot, was only to disengage instantaneously a large volume of steam of very high elasticity. Mr. Parkes contended, that an instance of the sudden production of hydrogen gas in a boiler under such circumstances was unknown, and he much doubted the possibility of such an occurrence. Again, allowing such an event to be possible, an explosive mixture of gases must be formed before the boiler could be destroyed; and this could not take place so long as a sufficiency of water was present, from which any considerable quantity of steam could be generated.

Mr. Donkin did not entirely agree as to the non-formation of hydrogen in boilers under peculiar circumstances. He conceived the explosions which occurred in iron founderies, on the contact of the melted metal with wet sand, to be analogous. He believed, that when water was thrown suddenly upon red hot plates, decomposition did occur.

He had once examined a wagon-shaped boiler which had exploded; the top was thrown to some distance, and the bottom was depressed throughout its entire length. He believed, that by intense firing the water had been nearly all evaporated; the bottom had then become red hot, the pressure of the steam had forced the bottom downwards when weakened by the heat; the water on each side then suddenly flowed on to the heated part, and an explosion instantly occurred.

Mr. Seaward had known instances of the internal tube of a boiler being collapsed without any injury to the external part or body of the boiler. He had always ascribed such occurrences to a deficiency of water; but Dr. Schafhaeutl's explanation of the rapid transmission of force through the wave to the bottom would sufficiently account for the effects which had been observed.

Mr. Donkin believed, that in almost every case the unequal pressure upon the exterior of the tube, arising from its not being perfectly cylindrical, was the cause of its collapsing.

Mr. Field was inclined to attribute all the explosions which he had witnessed to simple pressure.

When steam, or a small quantity of water, was suddenly admitted into a dry heated vessel, hydrogen gas was readily formed. He had

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* Tredgold on the Steam Engine, vol. i. p. 251. Edition by Woolhouse.

made several sets of apparatus for the purpose. A strong wrought iron tube was heated, and, being filled loosely with fragments of iron turnings, steam was introduced, and the gas was rapidly evolved.

He agreed with Mr. Parkes in condemning, generally, the fallacy of the opinion of Tredgold, previously mentioned, as to the formation of hydrogen gas. Still, in a large boiler, almost dry, and of which a portion was red hot, he conceived, that on the admission of a small quantity of water, hydrogen gas might be evolved.

The President was unwilling that this conversation should terminate without endeavoring to explain the cause of the elevation of the boilers from their seats. In his opinion, this might be satisfactorily accounted for by the action of atmospheric pressure.

When an explosion took place in a boiler, a considerable body of highly elastic fluid was disengaged; a partial vacuum was thus created above the boiler, whilst the full pressure of the atmosphere was exerted beneath it. This would cause the boiler to rise from its seat, provided the atmospheric air did not at the same instant rush into it, in which case the bottom would be pressed downwards, and the upper part being torn asunder, as had been described, would then rise into the air with the elastic fluid.

When it was considered that the superficial area of these boilers was about 60 square feet; that the pressure of the atmosphere was nearly 1 ton per square foot, and that the weight of the boilers was only 8 or 10 tons, it would be apparent that the cause was quite adequate to the effect, with a very partial vacuum or inequality of atmospheric pressure. The case was analogous to those in which light bodies were raised into the air by whirlwinds.

He referred also to two cases of an equally uncommon nature, which had lately come under his notice professionally, and which he considered to arise chiefly from inequality of atmospheric pressure.

The first occurred at the Plymouth Breakwater, during the great storm in the month of February, 1838, when several of the largest granite blocks, weighing from 3 to 8 tons each, composing the surface or pavement of the breakwater, which, although squared and dovetailed into the structure, and embedded in excellent cement to the extent of their whole depth, and thus forming a solid mass, were torn from their positions, and projected over the breakwater into the Sound. He attributed this to the hydrostatic pressure exerted beneath the stones, at the moment when the atmospheric pressure above had been disturbed by the masses of water suddenly and rapidly thrown upon the surface of the breakwater. Blocks of stone were thus often carried to a great distance, not so much by the waves lifting them, as by the vacuum created above them by the motion of the water, which exerted at the same time its full pressure from below.

The other case occurred during a storm in the year1840, when the sea door of the Eddystone lighthouse was forced outwards, and its strong iron bolts and hinges broken by the atmospheric pressure from within. In this instance, he conceived that the sweep of the vast body of water in motion round the lighthouse had created a partial and momentary, though effectual vacuum, and thus enabled the atmospheric pressure within the building to act upon the only yielding part of the structure.

EXTRACTS FROM NEW WORKS.

HISTORICAL NOTICE OF ELECTRICAL DISCOVERY.

BY DIONYSIUS LARDNER, D. C. L. &C.

[Continued from p. 215.]

Assuming these hypothetical principles, Franklin next proceeded to analyze the phenomena of the Leyden jar. His first experiments were directed to establish the fact, that when the jar is charged, the inside is electrified positively, and the outside negatively. A charged jar was placed on an insulating support, and a metallic wire bent into the form of a circular arc was then placed with one end in contact with the outer coating. The other end was capable of being brought into contact with the hook of the wire inserted through the cork, and thereby put in metallic communication with the water contained in the jar. This bent wire being supported by a handle of sealing wax, was itself insulated, and no electricity could pass in the experiment otherwise than between the inside of the jar and the coating on the outside. On bringing the upper extremity of the bent wire into contact with the hook, the jar was instantly discharged, both the inside and the outside being restored to their natural state. Franklin inferred from this, that before the discharge, the interior of the jar was *positively* electrified, and the exterior coating negatively electrified, in an equal degree; that is to say, that the interior of the jar contained an excess of electricity over and above its natural amount, and the exterior coating fell short of its natural amount by a quantity equal to that excess.

Various other experiments were made to verify this doctrine. Two metallic knobs were placed near each other, one communicating with the external coating, and the other with the water within the jar. A small cork ball suspended by a silk thread was placed between those two knobs. The ball was alternately attracted and repelled, "playing incessantly from one to the other, till the bottle was no longer electrized; that is, it fetched and carried fire from the top (inside) to the bottom (outside) of the bottle, till equilibrium was restored."*

It had been observed by electricians in Europe, that a jar could not be charged if its external coating were insulated; that, in fact, it was a necessary condition that a communication between that coating and the ground should be provided and maintained by some conducting matter, such as a metallic wire. Franklin assumes, that no electricity can be conveyed to the inside without causing the expulsion of an equal quantity from the outside, but if the jar be insulated, no means of escape being left for the electricity on the outside, no accumulation can take place on the inside.†

In these experiments, we find also a description of the method of charging a series of jars, now called the charge *by cascade.* "Suspend two or more phials on the prime conductor, one hanging on the tail of another, and a wire from the last to the floor. An equal number of turns of the wheel will charge them all equally, and every one as much

* Franklin's Works (Letters), vol. v, p. 192. Boston, 1837. † Ibid, p. 190.

as one alone would have been; what is drawn out of the tail of the first serving to charge (the inside of) the second; what is driven out of the second charging the third, and so on."*

In this way he constructed an electrical battery. After charging a series of jars, he separated them, putting the insides in metallic communication with each other, and the outsides, in like manner, in metallic communication. By such means he obtained discharges sufficiently powerful to kill the smaller animals.

But the experiment which appeared to be most conclusive in the support it gave to his hypothesis, of the transfer of the electricity from the exterior to the interior of the jar in the process of charging it, was the following :—A jar was suspended by its hook on the prime conductor of the machine, so that a metallic communication was maintained between the conductor and the inside of the jar. Meanwhile the rubber was insulated. On working the machine, the jar was found to receive no charge. A metallic wire was now rolled round the outer coating of the jar, and carried from thence to the rubber, so as to make a communication between them, both being still, in other respects, insulated. The jar was now charged with ease, which was explained by the supposition, that the electric fluid passed from the outside coating by the wire to the rubber, and thence by the glass globe and prime conductor to the inside of the jar.†

According to the hypothesis above stated, there is no essential distinction, so far as relates to the charge, between the external coating and the internal contents of the jar: the one ought to be as easily charged as the other. This was accordingly found to be the case. A jar was placed on an insulating support, and while the external coating was put in communication with the prime conductor of the machine, the wire extending from the interior was put in communication with the rubber. The electricity of the outer coating was now positive, and that of the inside negative; and the jar was discharged, and produced the same effects as before.

The next important investigation was as to the place in which the electricity of the jar was contained. To determine this, Franklin charged a jar, and insulated it. He then removed the cork, and the wire by which the electricity was conveyed from the machine to the inside of the jar. On examining these, he found them free from electricity. He next carefully decanted the water from the charged jar into another insulated vessel. On examining this it was found to be free from electricity. Other water in its natural state was now introduced into the charged jar to replace that which had been decanted; and on placing one hand on the outside coating, and the other in the water, he received the shock as forcibly as if no change had been made in the jar since it was first charged.‡

A piece of glass was then placed between two plates of lead extending nearly to its edge on every side. One of these plates of lead being touched by the hand, the other was charged with electricity as usual. The plates were then removed from the glass, and being examined, were found to be in their natural state. On presenting the finger to the

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* Letters, p. 199. † Ibid, p. 253. ‡ Ibid, p. 201.

glass where the lead had covered it, little sparks were received, and on displacing the lead, and touching it at both surfaces, a violent shock was received.

From this he inferred that the glass was the substance in which the electricity was deposited; and the metallic coating, or the water, or other conductor, applied to it, "served only, like the armature of the loadstone, to unite the forces of the several parts, and bring them at once to any point desired; it being the property of a non-electric (conductor) that the whole body instantly receives, or gives, what electrical fire is given to, or taken from, any one of its parts."*

From a very early period of the progress of electrical observations, the analogy between electricity and lightning had been noticed, and conjectures as to their identity were expressed; and in some cases distinct predictions hazarded, that the time would arrive which would fully establish their identity. Dr. Wall, in a paper published in the "Philosophical Transactions," speaking of the electricity of amber, said that he had no doubt, "that by using a longer and larger piece of amber, both the cracklings and the light would be much greater. *This* light and crackling seems in some degree to represent thunder and lightning."†

Mr. Grey, whose experiments have been already referred to, says, speaking of electrical effects, "These are at present but in *minimis*. It is probable that, in time, there may be found out a way to collect a greater quantity of electric fire, and consequently to increase the force of that power, which, by several of these experiments, *si licet magnis componere parva*, seems to be of *the same nature* with that of *thunder and lightning*."

But of all the anticipations which are pretended to of the grand discovery of the philosopher of Philadelphia, that which is by far the most remarkable, proceeded from his contemporary and competitor, the Abbé Nollet. Immediately after the first exhibition of the experiments, proving the identity of electricity and lightning, the Abbé urged his claim to a share of the merit of having suggested them. In a paper, dated Paris, June 6, 1752, the Abbé, after noticing the experiments, observes that he "is more interested than any one to come at the facts, which prove a true analogy between lightning and electricity, since these experiments establish incontestibly a truth which he had conceived, and which he ventured to lay before the public more than four years ago."

In the fourth volume of his "Leçons de Physique," is found the following passage:—"If any one should undertake to prove, as a clear consequence of the phenomenon, that thunder is, in the hands of nature, what electricity is in ours; that those wonders which we dispose at our pleasure are only imitations on a small scale of those grand effects which terrify us, and that both depend on the same mechanical agents—if it were made manifest that a cloud prepared by the effects of the wind by heat, by a mixture of exhalations, &c. is in relation to a terrestrial object what an electrified body is in relation to a body near it not electrified—I confess that this idea, well supported, would please me much; and

* Letters, p. 202.

† Priestley, History of Electricity, p. 11.

to support it, how numerous and specious are the reasons which present themselves to a mind conversant with electricity! The universality of the electric matter, the readiness of its action, its instrumentality, and its activity in giving fire to other bodies; its property of striking bodies externally and internally, even to their smallest parts (the remarkable example we have of this effect even in the Leyden jar experiment, the idea which we might truly adopt in supposing a greater degree of electric power); all these points of analogy which I have been for some time meditating, begin to make me believe that one might, by taking electricity for the model, form to oneself, in regard to thunder and lightning, more perfect and more probable ideas than any hitherto proposed."*

The volume containing this passage was printed and published towards the close of the year 1748, as appears by the register of the Academy of Sciences, in which the order to print it bears date on the 9th of August in that year. It will presently appear that Franklin's first publication of the same views was in a letter addressed to Mr. Collinson, dispatched in 1749. So far, therefore, as relates to these speculations, the priority of publication must be conceded to Nollet. It seems, however, improbable that Franklin, residing at Philadelphia, could have seen Nollet's volume between the date of his publication and the dispatch of his letter, an interval not exceeding a few months; and the probability is, therefore, that these views occurred simultaneously to the American and the French philosopher.

From the moment that Franklin first engaged in electrical inquiries, his views were constantly bent on the discovery of some useful purpose to which the science could be applied. *Cui bono*, was a question never absent from his thoughts.† This craving after *utility* was the great characteristic of his mind, and might be regarded as being carried almost to a fault. To bring the properties of matter and the phenomena of nature into subjection to the uses of civilized life, is undoubtedly *one* of the great incentives to the investigation of the laws of the material world; but it is assuredly a great error to regard it either as the only or the principal motive to such inquiries. There is in the perception of truth itself—in the contemplation of connected propositions, leading by the mere operation of the intellectual faculties, exercised on individual physical facts, to the development of those great general laws by

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* Nollet, Leçons de Physique, tom. iv, p. 315, 8mo. edition.

† After he had succeeded in making the discoveries which have been already explained, and besides inventing a little moving power which he called an *electrical jack*, he expressed to Mr. Collinson, in his usual playful manner, his disappointment at being unable to find any application of the science beneficial to mankind. "Chagrined a little that we have hitherto been able to produce nothing in this way of use to mankind, and the hot weather coming on when electrical experiments are not so agreeable, it is proposed to put an end to them for this season, somewhat humorously, in a party of pleasure on the banks of the Schuylkill. Spirits, at the same time, are to be fired by a spark sent from side to side through the river without any other conductor than the water; an experiment which we some time since performed, to the amazement of many. A turkey is to be killed for dinner by the *electrical shock*, and roasted by the *electrical jack*, before a fire kindled by the *electrified bottle*, when the healths of all the famous electricians of England, Holland, France, and Germany, are to be drank in *electrified bumpers*, under the discharge of guns from the *electrical battery*."—*Letters, p.* 210.

which the universe is maintained—an exalted pleasure, compared with which the mere attainment of convenience and utility in the economy of life is poor and mean. There is a nobleness in the power which the natural philosopher derives from the discovery of these laws, of raising the curtain of futurity, and displaying the decrees of nature, so far as they affect the physical universe for countless ages to come, which is independent of all utility. There is a lofty and disinterested pleasure in the mere contemplation of the harmony and order of nature, which is above and beyond mere utility. While we thus claim for truth and knowledge all the consideration to which, on their own account, they are entitled, let us not be misunderstood as disparaging the great benefactors of the human race, who have drawn from them those benefits which so much tend to the well being of man. When we express the enjoyment which arises from the beauty and fragrance of the flower, we do not the less prize the honey which is extracted from it, or the medicinal virtues it yields. That Franklin was accessible to such feelings, the enthusiasm with which he expresses himself throughout his writings in regard to natural phenomena abundantly proves. Nevertheless, *useful application* was, undoubtedly, ever uppermost in his thoughts; and he probably never witnessed any physical fact, or considered for a moment any law of nature, without inwardly proposing to himself the question, "In what way can this be made beneficial in the economy of life?"

The analogy and probable identity of lightning and electricity were first suggested and demonstrated by Franklin, in a letter addressed to Collinson, which appears without a date, and which has been referred to the date (1750) of that which immediately follows it in the published collection of letters. It appears, however, by a subsequent letter,* addressed to the same gentleman in 1753, that he was occupied in the investigation of this question from 1747 to 1749; that the paper now referred to was first written in the former year, but that it was enlarged and improved and sent to England in 1749, which must, therefore, be taken as its date. In this letter he enters very fully into his reasons for considering the cause of electricity and lightning to be the same physical agent, differing in nothing save the intensity of its action; and he truly observes, that the difference in degree, however enormous, is no argument against the identity of the agents, but that, on the contrary, an almost infinite difference might be naturally looked for. "When a gun barrel in electrical experiments has but little electrical fire in it, you must approach it very near with your knuckle before you can draw a spark. Give it more fire, and it will give a spark at greater distance. Two gun-barrels united, and as highly electrified, will give a spark at a still greater distance. But if two gun-barrels electrified will strike at two inches distance, and make a loud snap, to what a great distance may ten thousand acres of electrified cloud strike and give its fire, and how loud must be that crack!"†

The analogies which he stated as affording presumptive evidence of the identity of lightning and electricity, may be briefly enumerated.

* "In my former paper on this subject, written first in 1747, enlarged and sent to England in 1749, I considered the sea as the great source of lightning," &c.—*Letters, p.* 300.

† Letters, p. 218.

The electrical spark is zigzag, and not straight; so is lightning. Pointed bodies attract electricity; lightning strikes mountains, trees, spires, masts, and chimneys. When different paths are offered to the escape of electricity, it chooses the best conductor; so does lightning. Electricity fires combustibles; so does lightning. Electricity fuses metals; so does lightning. Lightning rends bad conductors when it strikes them; so does electricity when rendered sufficiently strong. Lightning reverses the poles of a magnet; he proved by direct experiment that electricity had the same effect. A stroke of lightning, when it does not kill, often produces blindness; he rendered a pigeon blind by a shock of electricity, intending to kill it. Lightning destroys animal life; he killed a hen and a turkey by electrical shocks.

Having ascertained by experiment the property of points in attracting and discharging electricity, Franklin, acknowledging his inability to give a satisfactory theory of this effect, set himself to inquire how "this power of points might possibly be of some use to mankind." To discover this, he suspended a large conductor, by silk lines, from the ceiling, and charged it with electricity, so as to enable it to give a spark at the distance of two inches, "strong enough to make one's knuckles ache." Under these circumstances, he found that, if a person presented the point of a needle to the conductor at more than a foot distance, no electricity could be retained upon it, all passing off by the needle as fast as it was supplied. He also found, that if, after it was strongly electrified, the needle was presented at the same distance, the conductor would instantly lose its electricity. That the electricity, in this case, really passed off by the point, he ascertained by observing that, in the dark, the light was visible on the point of the needle; and also because, when the person presenting the needle was himself insulated, or stuck the needle in a bundle of sealing wax, the electricity no longer escaped.

The next experiment is so remarkable in itself, and so characteristic of the mind of Franklin, that we shall give it in his own words:—

"Take a pair of large brass scales, of two or more feet beam, the cords of the scales being silk. Suspend the beam by a packthread from the ceiling, so that the bottom of the scales may be about a foot from the floor; the scales will move round in a circle by the untwisting of the packthread. Let an iron punch (a silversmith's iron punch, an inch thick, is what I use) be put on the end upon the floor, in such a place as that the scales may pass over it in making their circle; then electrify one scale by applying the wire of a charged phial to it. As they move round, you see that scale draw nigher to the floor, and dip more when it comes over the punch; and, if that be placed at a proper distance, the scale will snap, and discharge its fire into it. But if a needle be stuck on the end of the punch, its point upwards, the scale, instead of drawing nigh to the punch and snapping, discharges its fire silently through the point, and rises higher from the punch. Nay, even if the needle be placed upon the floor near the punch, its point upwards, the end of the punch, though so much higher than the needle, will not attract the scale and receive its fire, for the needle will get it, and convey it away, before it comes nigh enough for the punch to act.

"Now, if electricity and lightning be the same, the conductor and scales may represent electrified clouds. If a tube (conductor) of only

ten feet long will strike and discharge its fire on the punch at two or three inches distance, an electrified cloud of perhaps ten thousand acres may strike and discharge on the earth at a proportionally greater distance. The horizontal motion of the scales over the floor may represent the motion of the clouds over the earth, and the erect punch a hill or high building; and then we see how electrified clouds, passing over hills or high buildings at too great a height to strike, may be attracted lower till within their striking distance. And, lastly, if a needle fixed on the punch with its point upright, or even on the floor below the punch, will draw the fire from the scale silently at a much greater than the striking distance, and so prevent its descending towards the punch; or if in its course it would have come nigh enough to strike, yet, being first deprived of its fire, it cannot, and the punch is thereby secured from the stroke; I say, if these things are so, may not the knowledge of this power of points be of use to mankind in preserving houses, churches, ships, &c. from the stroke of lightning, by directing us to fix, on the highest parts of those edifices, upright rods of iron, made sharp as a needle, and gilt to prevent rusting; and from the foot of those rods, a wire down the outside of the building into the ground, or down round one of the shrouds of a ship, and down her side till it reaches the water? Would not these pointed rods probably draw the electrical fire silently out of a cloud before it came nigh enough to strike, and thereby secure us from that most sudden and terrible mischief?"

"To determine this question, whether the clouds that contain lightning be electrified or not, I would propose an experiment to be tried, where it may be done conveniently. On the top of some high tower, or steeple, place a kind of sentry box, big enough to contain a man and an electrical stand. From the middle of the stand let an iron rod rise, and pass, bending, out of the door, and then upright twenty or thirty feet, pointed very sharp at the end. If the electrical stand be kept clear and dry, a man standing on it, when such clouds are passing low, might be electrified, and afford sparks, the rod drawing fire to him from a cloud. If any danger to the man be apprehended, let him stand on the floor of his box, and now and then bring near to the rod the loop of a wire that has one end fastened to the leads, he holding it by a wax handle; so the sparks, if the rod is electrified, will strike from the rod to the wire, and not affect him."*

When this and other papers by Franklin, illustrating similar views, were sent to London, and read before the Royal Society, they are said to have been considered so wild and absurd that they were received with laughter, and were not considered worthy of so much notice as to be admitted to a place in the "Philosophical Transactions."† They were, however, shown to Dr. Fothergill, who considered them of too much value to be thus stifled; and he wrote a preface to them, and published them in London. They subsequently went through five editions.

After the publication of these remarkable letters, and when public opinion in all parts of Europe had been expressed upon them, an abridgment or abstract of them was read to the Society on the 6th of

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* Letters, p. 235. † Franklin's Works, (Memoirs) vol. i, p. 299.

June, 1751. It is a remarkable circumstance, that, in this notice, no mention whatever occurs of Franklin's project of drawing lightning from the clouds. Possibly this was the part which had before excited laughter, and was omitted to avoid ridicule.

Franklin was under an impression that a pointed rod could not be expected to attract the lightning, unless it were placed at a very great height in the atmosphere; and to render the result of his projected experiment more certain, he determined to wait for the completion of a spire then being erected in Philadelphia. Meanwhile, however, a different and more promising expedient occurred to him, which was, to send up the pointed wire upon a kite, by the string of which the lightning might be brought within his reach. He soon succeeded in realizing this, the most bold and grand conception which ever presented itself to the imagination of an experimental philosopher.

He prepared his kite by making a small cross of two light strips of cedar, the arms of sufficient length to extend to the four corners of a large silk handkerchief stretched upon them. To the extremities of the arms of the cross he tied the corners of the handkerchief. This being properly supplied with a tail, loop, and string, could be raised in the air like a common paper kite, and, being made of silk, was more capable of bearing rain and wind. To the upright arm of the cross was attached an iron point, the lower end of which was in contact with the string by which the kite was raised, which was a hempen cord. At the lower extremity of this cord, near the observer, a key was fastened; and, in order to intercept the electricity in its descent, and prevent it from reaching the person who held the kite, a silk ribbon was tied to the ring of the key, and continued to the hand by which the kite was held.

Furnished with this apparatus, on the approach of a storm, he went out upon the commons near Philadelphia, accompanied by his son, to whom alone he communicated his intentions, well knowing the ridicule which would have attended the report of such an attempt, should it prove to be unsuccessful. Having raised the kite, he placed himself under a shed, that the ribbon by which it was held might be kept dry, as it would become a conductor of electricity when wetted by rain, and so fail to afford that protection for which it was provided. A cloud, apparently charged with thunder, soon passed directly over the kite. He observed the hempen cord, but no bristling of its fibres was apparent, such as was wont to take place when it was electrified. He presented his knuckle to the key, but not the smallest spark was perceptible. The agony of his expectation and suspense can be adequately felt by those only who have entered into the spirit of such experimental researches. After the lapse of some time, he saw that the fibres of the cord near the key bristled and stood on end. He presented his knuckle to the key, and received a strong bright spark. It was lightning. The discovery was complete, and Franklin felt that he was immortal.

A shower now fell, and wetting the cord of the kite, improved its conducting power. Sparks in rapid succession were drawn from the key, a Leyden jar was charged by it, and a shock given; and, in fine, all the experiments which were wont to be made by electricity, were reproduced identical in all their concomitant circumstances.

This experiment was performed in the month of June, 1752. It will

be remembered that Franklin's letters to Mr. Collinson had been previously published, translated, and widely circulated in different languages throughout Europe; and in these letters, not only the object of the experiment and the principle it was designed to establish were fully explained, but minute and circumstantial directions were given as to the manner of executing it. Persons engaged in physical inquiries in different parts of Europe were invited, and prepared to submit it to a trial when convenient opportunities offered. Among these was a French electrician, M. Dalibard, who, in the spring of 1752, prepared means of making the experiment at Marly-la-Ville, a place situate about 6 leagues from Paris. He succeeded on the 10th of May, about a month before the experiment of Franklin, and made a report of his proceedings to the Academy of Sciences at Paris, on the 13th, in which he states that the experiment had been made at the suggestion, and according to the method laid down by Franklin.* The experiment of Franklin, in June, was made before he could have been informed of that of Dalibard. The same experiment was repeated on the 18th of May, by M. de Lor, at his house in the Esplanade, at Paris, and an account of it, as well as that of M. Dalibard, was communicated to the Royal Society of London by the Abbé Mazeas, in a letter dated 20th May, two days after the latter experiment, in which the Abbé ascribes all the credit of the experiment to Franklin.†

The right of Franklin to the credit of having established the identity of lightning and electricity has been denied, and the honor claimed for the French philosophers Nollet and Dalibard. This claim was advanced, not when Europe from east to west, and from north to south, was filled with amazement and admiration at the philosophic boldness of the "Philadelphian experiment, (as it was universally called) or the profound sagacity with which it was conceived, with which its minute details were prescribed, and its results foretold—not when its illustrious author was elected by acclamation a member of the learned societies of Europe, and received the academical degree from the most ancient and honored of universities—but after the lapse of nearly a century, after the story of Franklin's kite had passed from the transactions of philosophical societies, and the memoirs of institutes of sciences, into the primers of children. In short, it was so recently as the year 1831, that, in his admirable *Eloge* of Volta, M. Arago, taking a retrospect of electrical discovery, maintained that after the conjecture of Nollet, on the identity of lightning and electricity, an experiment to ascertain the fact was *almost useless*. And the reasons he assigned for such inutility were, that the experiment had been first made when flame appeared on the spears of soldiers, and the masts of ships;‡ but that, if any credit be

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* "En suivant la route que M. Franklin nous a tracée, j'ai obtenu une satisfaction complète."—*Mémoir de M. Dalibard*, quoted in Franklin's Works, vol. v, p. 288.

† See Phil. Trans. vol. xvii, 1752.

‡ "Les premières vues de Franklin sur l'analogie de l'électricité et du tonnerre n'étaient, comme les idées antérieures de Nollet *que de simple conjectures*. Toute la différence, entre le deux physiciens, se réduisait alors à un projet d'expérience, dont Nollet n'avait pas parler. . . . . Sans porter atteint à la gloire de Franklin, je dois remarquer que l'expérience proposée était presque inutile. Les soldats de la cinquième legion Romaine l'avaient déja faite pendant la guerre d'Afrique, le jour où, comme César le rapporte, le fer de tous les javelots parut en feu à la suite d'un

claimed for the actual exhibition of the fact by immediate experiment, that credit is due to M. Dalibard.

If such a statement, supported by such a reason, had proceeded from a quarter less entitled to respect than the "Perpetual Secretary of the Academy of Sciences," the astronomer royal of France, the man who stands, if not first, incontestably in the first rank of living meteorologists —in a word, than M. Arago—no one would think it entitled to a serious answer. It would be classed among those strange obliquities of historic vision which have led some persons to see in Richard and Macbeth, not tyrants and murderers, but mild and virtuous princes, cruelly wronged by the calumnies of tradition.

Nollet conjectured the probable identity of lightning and electricity, but gave not the most distant hint of any possible method by which the probability could be experimentally tested. Franklin boldly maintained the identity of these agents, gave numerous and cogent reasons to support that position, and moreover prescribed with minute details two distinct methods by which lightning could be brought into the hands of the observer, and submitted to the same experimental examination as electricity had undergone. One of these two methods was, in scrupulous accordance with his directions, applied in France; and the other, within a few weeks, was adopted by himself in America. The results of both were precisely what Franklin had foretold. Both were completely successful.

But, rejoins M. Arago, the whole affair of the experiment was useless, for it had already been effected. The flame on the javelins of the Roman sentinels of the fifth legion was sufficient as an experiment, not to mention *Castor* and *Pollux*, so often seen by sailors on their mast tops! What would so severe a reasoner as M. Arago say to another who should maintain, without further experiments, that either of these luminous appearances was identical with lightning?—and if that were conceded, where would have been found the proof that these meteors, and the lightning with which they would be granted to be identified, were due to the same physical agent as that manifested by the friction of glass and resin?

If however, says M. Arago again, the experiment *were* necessary or useful, science owes it to M. Dalibard, who executed it at Marly-la-Ville a month before Franklin, with his kite, made it at Philadelphia. This statement is not attended with the circumstantial accuracy which M. Arago is accustomed to observe. The fact as stated by M. Dalibard himself was, that he took Franklin's printed directions as to the manner of performing his (Franklin's) projected experiment, and followed them to the letter in preparing his apparatus at Marly-la-Ville. Having ac-

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orage. Il en est de même des nombreux navigateurs à qui *Castor et Pollux* s'étaient montrés, soit aux pointes métalliques des mâts ou des vergues, soit sur d'autres parties saillantes de leurs navires. . . . . Au reste, soit que plusieurs de ces circonstances fussent ignorées, soit qu'on ne les trouvât pas démonstratives, des essais directs semblèrent nécessaires, et c'est à Dalibard, notre compatriote, que la science en a été redevable. Le 10 Mai, 1752, pendant un orage, la grande tige de métal pointue qu'il avait établie dans un jardin de Marly-la-Ville donnait de petites étincelles, comme le fait le conducteur de la machine électrique ordinaire, quand on en approche un fil de fer. Franklin ne réalisa cette même expérience aux Etats-Unis, à l'aide d'un cerf volant, qu'un mois plus tard."—*Eloge de Volta, p.* 12.

complished this, he put the directions for making the observation into the hands of one Coiffier, an old retired soldier, who followed the trade of a carpenter, and who probably also erected the apparatus itself, and desired Coiffier to make the experiment in the manner prescribed by Franklin, if a storm should occur at a time when he (Dalibard) was absent. The first storm did occur when Dalibard was at Paris. Coiffier presented a piece of metal to the rod, and received several sparks. He then ran for the curé, who, with him, repeated the experiment, and immediately wrote a full description of it, with which he dispatched Coiffier himself to Paris to M. Dalibard.

Thus, it appears, that so far from science being indebted to M. Dalibard for the earliest exhibition of this capital experiment, that philosopher had no other share in it save that of having caused the erection of the conducting rod and other apparatus according to Franklin's directions. In the actual performance of the first experiment, he had no share whatever.

Let us now see how the account of credit stands on the score of this memorable discovery :—

In 1708, Dr. Wall mentions a *resemblance* of electricity to thunder and lightning.

In 1735, Mr. Grey *conjectures* their *identity*, and that they differ only in *degree*.

In 1748, the Abbé Nollet reproduces the conjecture of Grey, attended with more circumstantial reasons.

In 1749, Franklin strongly maintains their *identity*, and accurately describes two ways of experimentally testing it, and sends his instructions to Europe, to enable others with better local opportunities than he possessed to try it.

In 1752, M. Dalibard and Delor, in France, made the preparations prescribed according to one of Franklin's methods ; and Franklin makes in Philadelphia preparations according to the other method.

On 10th May, 1752, Coiffier and the curate make the experiment as directed by Franklin, and obtain the results foretold by Franklin.

In June, 1752, Franklin makes the same experiment in Philadelphia, according to the other method, with like results.

If the credit of the discovery is due to him who first conjectured the identity of lightning and electricity, then it is due to Mr. Stephen Grey.

If it be due to him who showed the method of making the capital experiment by which the identity must be either established or refuted, it belongs to Franklin.

If it be due to the persons at whose expense Franklin's apparatus was first constructed, it must be shared between Franklin, Dalibard, and Delor.

If it be due to him, who, first in person, *performed* the experiment proposed by Franklin, it must be accorded to the carpenter and dragoon Coiffier.

We shall now dismiss this matter, to which more space has been allotted than it is entitled to, merely observing, that much as living philosophers must be surprised at the claim advanced in favor of M. Dalibard, that electrician himself, could he rise from his tomb, would

see with infinitely more astonishment, an honor sought for him to which he never himself aspired, or supposed he had the slightest title.

Franklin having established, beyond the possibility of dispute, the identity of lightning and electricity, proceeded, in accordance with that characteristic attribute of his mind already noticed, to turn this discovery to the benefit of mankind, and proposed the general adoption of those pointed metallic rods now so commonly erected at the summits of buildings to protect them from the effects of lightning. The principle of this apparatus, as now constructed for edifices and ships, differs in nothing essential from that proposed by its celebrated inventor.

This part of the labors of Franklin in electricity cannot be dismissed without a passing notice of the dispute which was maintained in England respecting the comparative advantages of conductors with pointed ends as proposed by Franklin, or with round or blunted ends as suggested by some others. It were for the honor of science that this discreditable controversy had never taken place. It forms a rare, if not a solitary example, of the prostitution of philosophy to gratify the meanest passions of an obstinate and imbecile prince. The persevering tenacity with which the British monarch fastened his last grasp on his American subjects, about to wrest themselves from his power, and assert their independence, is well known. By his pursuit of that object, after all reasonable hope of securing it had expired, the treasures of his kingdom were lavished, and the blood of his people flowed in mutual slaughter. Bad as were these consequences, they were nevertheless the ordinary consequences of war. But the vindictive spirit of the court passed from the field and council board to the peaceful halls of science; and because Franklin, the agent, representative, and counsellor of the American people, had proposed the use of *pointed* conductors, a party of parasites was found, who, to gratify George III, advocated *blunt* conductors; and, to crown this most egregious absurdity, *blunt conductors* were actually erected upon the royal palace!*

Franklin next directed his inquiries to the quantity and nature of the electricity with which the clouds in various states of the atmosphere were charged. To facilitate his experimental inquiries on this subject, he erected in his house in Philadelphia a pointed iron rod, which he was enabled to insulate at pleasure. This rod was put in communication with a system of bells, which alternately attracted and repelled their hammers when electrified. Whenever a cloud charged with electricity passed over the house within such a distance as to affect the conductor, these bells would ring and inform him of the opportunity of prosecuting his experiments.

Having satisfied himself that the clouds were frequently in an electrified state, when there was no thunder or lightning, his next inquiry was, whether they were electrified positively or negatively. This was a question of more interest to him, because, according to his theory, if their electricity were negative, the earth, "in thunder strokes, would

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* "The king's changing his *pointed* conductors for *blunt* ones is a matter of small importance to me. If I had a wish about them, it would be, that he would reject them altogether as ineffectual. For it is only since he thought himself and his family safe from the thunder of heaven that he has dared to use his own thunder in destroying his innocent subjects."—*Franklin's Works*, viii, 227.

strike into the clouds, and not the clouds into the earth." To determine this, he "took two phials, and charged one of them with lightning from the iron rod, and gave the other an equal charge (of electricity) from the prime conductor. When charged, he placed them on a table within three or four inches of each other, a small cork ball being suspended by a fine silk thread from the ceiling, so as to play between the wires. If both bottles then were electrified *positively*, the ball being attracted and then repelled by the one, must be repelled by the other. If the one *positively* and the other *negatively*, then the ball would be attracted and repelled by each, and continue to play between them, so long as any considerable charge remained."*

From experiments with this apparatus, he concluded that clouds were sometimes *positively* and sometimes *negatively* electrified, but oftener *negatively*. Electrical instruments had not yet, however, advanced to such a state of improvement as to enable a mind, even acute as his, to make much further discovery in atmospheric electricity; and although the details of his experiments and his theoretical speculations regarding them must always be read with profound interest, yet no further principles of importance appear to have been evolved from them.

If it be true that the Royal Society laughed at his speculations, and refused to them a place in their transactions, they were not slow to retract and repair their error. They conferred upon him their highest honor (the Copley medal) and unanimously elected him an honorary member of their society in 1753.

An experiment so remarkable as the attraction of lightning from the clouds, could not fail to be verified and repeated by many enthusiastic lovers of science. One of the first instances of this zeal was rendered memorable by its fatal result. Professor George William Richmann, of St. Petersburgh, was preparing an essay on electricity, and in order to obtain the most certain and accurate knowledge of the phenomena, he placed a conductor on his house, making a metallic communication between it and his study, where he provided means for repeating Franklin's experiments. On the 6th of August, 1753, while Richmann attended a meeting of the Petersburgh Academy of Science, distant thunder was heard, on which he went to his house, accompanied by Sokolow the engraver, who being engaged to illustrate his work, desired to see those electrical appearances which he would have to represent in the plates. While Richmann was describing to Sokolow the nature of the apparatus, a thunder clap was heard louder and more violent than any which had been remembered at St. Petersburgh. Richmann stooped towards the electrometer of the apparatus to observe the force of the electricity, and "as he stood in that posture, a great white and blueish fire appeared between the rod of the electrometer and his head. At the same time a sort of steam or vapor arose which entirely benumbed the engraver, and made him sink on the ground." Several parts of the apparatus were broken in pieces and scattered about. The doors of the room were torn from their hinges, and the house shaken in every part. The wife of the professor, alarmed by the shock, ran to the room, and found her husband sitting on a chest, which

* Letters, p. 302.

happened to be behind him when he was struck, and leaning against the wall. He appeared to have been instantly struck dead.*

During 1752 and the succeeding years, the subject of atmospheric electricity engaged the attention of persons devoted to physical science in different parts of Europe. The climate of England being less favorable to such researches than more southern latitudes, fewer opportunities of observation were offered; nevertheless, Canton, Wilson and Bevis soon repeated and verified the Philadelphia experiments. Canton showed that the clouds were electrified, sometimes negatively and sometimes positively, and carried such observations further than Franklin.

But the most acute and indefatigable follower of Franklin at this time, in atmospheric electricity, was Beccaria, who, in 1753, published a treatise on electricity at Turin, and a series of letters on the same subject at Bologna in 1758. He erected numerous conducting rods in different places of observation, and elevated kites according to Franklin's method. By raising these to various heights, he observed the electricity of different atmospheric strata, and he improved this mode of observation by interlacing the strings with metallic wire. To keep his kites constantly insulated, and at the same time to give them more or less string, he rolled the string upon a reel, which was supported by pillars of glass, and his conductors were placed in metallic communication with this reel.

This profound philosopher, and acute and accurate observer, has left in the history of electricity traces of his genius second only to those with which Franklin and Volta impressed it. Beccaria was the first who diligently studied and recorded the circumstances attending the phenomena of a thunder storm. He observes that the first appearance of a thunder storm (which generally happens when there is little or no wind) is one dense cloud or more, increasing rapidly in magnitude, and ascending into the higher regions of the atmosphere. The lower edge is black and nearly horizontal, but the upper is finely arched and well defined. Many of these clouds often seem piled one upon the other, all arched in the same manner, but they keep constantly uniting, swelling, and extending their arches. When such clouds rise, the firmament is usually sprinkled over with a great number of separate clouds of odd and bizarre forms, which keep quite motionless. When the thunder cloud ascends, these are drawn towards it, and as they approach they become more uniform and regular in their shapes, till coming close to the thunder cloud, their limbs stretch mutually towards one another, finally coalesce, and form one uniform mass. But sometimes the thunder cloud will swell and increase without the addition of these smaller adscititious clouds. Some of the latter appear like white fringes at the skirts of the thunder cloud or under the body of it, but they continually grow darker and darker as they approach it.

When the thunder cloud, thus augmented, has attained a great magnitude, its lower surface is often ragged, particular parts being detached towards the earth, but still connected with the rest. Sometimes the lower surface swells into large protuberances, tending uniformly towards

* Phil. Trans. vol. xlix, p. 61.

the earth, and sometimes one whole side of the cloud will have an inclination to the earth, which the extremity of it will nearly touch. When the observer is under the thunder cloud after it has grown large and is well formed, it is seen to sink lower and to darken prodigiously, and, at the same time, a great number of small clouds are observed in rapid motion, driven about in irregular directions below it. While these clouds are agitated with the most rapid motions, the rain generally falls in abundance, and if the agitation be very great, it hails.

While the thunder cloud is swelling and extending itself over a large tract of country, the lightning is seen to dart from one part of it to another, and often to illuminate its whole mass. When the cloud has acquired a sufficient extent, the lightning strikes between the cloud and the earth in two opposite places, the path of the lightning lying through the whole body of the cloud and its branches. The longer this lightning continues, the rarer does the cloud grow, and the less dark in its appearance, till it breaks in different places and shows a clear sky. When the thunder is thus dispersed, those parts which occupy the upper regions of the atmosphere are spread thinly and equally, and those that are beneath are black and thin also, but they vanish gradually without being driven away by any wind.

The instruments for electrical observation, used by Beccaria, never failed to give indications corresponding to the successive changes in progress in the atmosphere above the observatory. The stream of fire from his conductor was generally uninterrupted while the thunder cloud was directly above it. The same cloud, in its passage, electrified his conductor alternately with positive and negative electricity. The electricity of the conductor continued to be of the same kind so long as the thunder cloud was simple and uniform in its direction. But when the lightning changed its place, a change in the species of electricity ensued. A sudden change of this kind would also happen after a violent flash of lightning; but the change would be gradual when the lightning was moderate, and the progress of the thunder cloud slow.*

But among the labors of this philosopher, that rendered by modern discoveries most memorable, was one which by his contemporaries and their immediate successors was regarded as an ingenious and over refined conjecture, rather than what it afterwards proved to be, the distant shadow of a coming discovery detected by the far-sighted mind of this acute and extraordinary man. Franklin had been the first to magnetize fine sewing needles by the electric spark. Dalibard observed that the extremity of the needle at which the spark from the excited glass entered had northern polarity, and both Franklin and Dalibard discovered that a spark of equal force given to the other end of the needle deprived it of the magnetic virtue. From these and from similar experiments made by himself, Beccaria inferred† that the polarity of the magnetic needle was determined by the direction in which the electric current had passed through it. He assumed the magnetic polarity acquired by ferruginous bodies which had been struck by lightning, as a

* Beccaria, Lettere dell' Elettricismo. Bologna, 1758, p. 146, *et seq.*

† "I poli del mattone teste descritto, provano che anche in certi corpi che abbiano certa porzione di ferro, *il fulmine imprime un segno permanente della sua direzione.*"—*Beccaria, Lettere, p.* 261.

test of the direction of the electric current in passing through them, and thence inferred the species of electricity with which the thunder cloud had been charged.

Extending this analogy to the earth itself, Beccaria conjectured that terrestrial magnetism was like that of the needle magnetized by Franklin and Dalibard, the mere effect of permanent currents of natural electricity, established and maintained upon its surface by various physical causes; that, as a violent current, like that which attends the exhibition of lightning, produces instantaneous and powerful magnetism in substances capable of receiving that quality, so may a more gentle, regular, and constant circulation of the electric fluid upon the earth impress the same virtue on all such bodies as are capable of it. Observation proves that a vast quantity of this fluid circulates between different parts of the atmosphere in storms; that a quantity not inconsiderable circulates in the time of ordinary rain; and that, even when the weather is serene and the heavens unclouded, some quantity is still observable. "Of such fluid, thus ever present," observes Beccaria, "I think that some portion is constantly passing through all bodies situate on the earth, especially those which are metallic and ferruginous; and I imagine it must be those currents which impress on fire-irons, and other similar things, the power which they are known to acquire of directing themselves according to the magnetic meridian when they are properly balanced."*

He observed, that to say we are insensible to this current around us, is no good argument against its existence; for that its uniformity, constancy and universality would necessarily render it imperceptible, since all bodies must partake of it in common. His hypothesis to account for the *variation* and *dip* is not the least remarkable part of this extraordinary anticipation. He considers that the electro-magnetic currents have not all a common centre, but may have several situate in our northern hemisphere. The aberration of their common centre from the true terrestrial pole may probably be the cause of the variation of the compass. The periodical change to which the position of this common centre is subject, would correspond with, and cause the periodical change of that variation, and the obliquity of these currents may be the cause of the dip.†

(TO BE CONTINUED.)

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*"Di tale fuoco, io penso che alcuna parte perpetuamente discorra per tutti i corpi situati sopra la terra, massimamente per i metallici e ferigni. Penso che esso sia, il quale attra versando le padelle, le molle, le palette ed altri si fatti bislunghi ferri, i quali d'ordinario pendono o posano verticalmente, imprima loro la virtù di situarsi nella meridiana magnetica, allora che sono convenientemente bilicati."—*Lettere*, p. 266.

†Questa sistematica ellettrico-magnetica circolazione, secondo me, non procederebbe da un solo punto settentrionale, ma aurebbe infinite sorgenti in diversi punti del nostro settentrionale emisfero, forse successivamente, più folte nè luoghi più vicini ad alcun punto settentrionale; e la frequenza, la posizione, o piuttosto la direzione del corso loro mi si rappresenterebbono dalla posizione, frequenza, e diverzione, con che si dispongono intorno alli emisferi di una sferica calamita le ordinatissime filze della limitura di ferro. E giusta una tale ipotesi, l' aberrazione del centro comune di tutte le varie sorgenti, che estenderebbono la loro azione ad una data ragione, del vero punto settentrionale mi spiegherebbe l' aberrazione della calamita; il periodo di quella aberrazione mi spiegherebbe il periodo di questa declinazione; l' obbliquità, con che quelle sorgenti spiccierebbono da terra, e si direggerebbono verso mezzo dì, mi spiegherebbe e la inclinazione degli aghi, e la particolare facilità con che si calamitano i ferri si fattamente incliuati.—*Lettere*, *p.* 268.

MISCELLANEOUS.

New Mode of Preserving Meat.—At a late meeting of the Academy of Sciences, M. Gannal presented an important essay, which is likely to produce a considerable sensation amongst the public as well as in the scientific world. M. Gannal has been for many years occupied with the idea of preserving meat by injection. Thus, 4 lb. weight of saline mixture injected into the carotid artery of an ox, penetrates all the vessels, and prevents putrid decomposition. M. Gannal exhibited legs of mutton preserved two years since by this plan, and which were found to be perfectly sweet. M. Gannal employs for this purpose the muriate of alum. This discovery is considered valuable in preserving provisions for the navy. Inventors' Adv.

Improvement in Tinning Vessels.—This invention relates to a mode of combining nickel and iron with tin, in order to improve the tinning of metal surfaces.

The proportions of nickel and iron, mixed with the tin, in order to produce the best tinning, are—ten ounces of the best nickel, and seven ounces of sheet iron, to ten pounds of tin.

The temperature at which nickel is fusible being higher than that required to bring tin into a state of fusion, it is necessary to prevent the tin as it melts from evaporating (as it is essential that the two metals be put into the same crucible): this object is obtained by adding to ten pounds of the composition one ounce of borax and three ounces of pounded glass; the heat soon causes the borax to bubble up, which augments its volume, and causes it to unite with the melted glass without mixing with the metals. The lightness of these two substances in comparison with the metals, causes them to rise to the surface, where they form a crust, which prevents the action of the air on the metals, the fusion of which proceeds under the influence of a concentrated heat. The fusion is completed in about half an hour, when the composition is run off through a hole in the crust.

In tinning metals with this composition the workman proceeds in the ordinary manner. Ibid

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Glass Bells.—Glass church bells are among modern wonders. One has just been cast in Sweden. Its diameter is six feet, and its tone is said to be finer than any metal bell.

New Mode of Steering.—At a late meeting of the Institution of Civil Engineers, Capt. Henderson described a new mode of steering boats of light draught of water, navigating shallow and rapid rivers. The ordinary method of steering with a single rudder, fixed in the usual manner, will bring a vessel round in about four times its length, upon an axis at the point of union between the dead wood of the vessel and

the rudder. It was found desirable for particular service on the Ganges and Burhampooter, that great facility should be given for coming round rapidly; to accomplish this, the stem and stern of the vessel are alike provided with rudders, of a form adapted to the curvature of the craft. The stern rudder is considerably larger than the other, and occupies the space usually allotted to the dead wood, which is cut away; a more immediate influence is thus exerted upon the boat. The rudders are raised or lowered according to the draught of water, by means of capstans fixed upon the projecting ends of the shaft of a pinion, which is geared into a toothed rack of a peculiar construction, on the back of each rudder post. The effect of this arrangement is, that the centre of revolution is transferred to a point nearer the centre of the vessel, and deviating from the true centre in proportion to the relative dimensions, position, and figure of the two rudders, and of the lines forward and abaft the vessel, which is thus brought round in little more than its own length. Ibid

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Chinese Musical Instrument.—At a recent sitting of the Royal Society an interesting paper by G. T. Lay, Esq. upon "The Scholar's Lute among the Chinese" was read. The Kin, which is the stringed instrument here described, was the one played upon by Confucius and the sages of antiquity, and is therefore held sacred by men of letters. It is made of the Woo-tung, or *Dryandria cordifolia.* It is convex above and plane below, and is wider at one end than at the other; it has two quadrangular apertures in the plane surface, which open into as many hollows within the body of the instrument; and it is furnished with seven silken strings of different diameters, which pass over the smaller end, and are distributed between two immoveable pegs below. A bridge within a short distance of the wider extremity gives these strings the necessary elevation and a passage to the under surface, where, by means of a row of pegs, they are tightened or relaxed at pleasure. The length of the sounding board is divided by thirteen studs of nacre, or mother-of-pearl, as a guide for the performer; and they are placed so that the length of each string is bisected, trisected, &c., that is, divided into aliquot parts as far as the eighth subdivision, with the omission of the seventh, the number of sections being represented by the arithmetical series

2, 3, 4, 5, 6, 0, 8.

Thus the intervals, or magnitudes of the different tones sounded by this instrument, do not accord with those produced on our violin, but agree more with the old Scotch music. The study of this instrument, and the art of playing upon it, are rendered extremely difficult by the complexity of the Chinese notation of written music, which leads to frequent omissions and blunders. Thus every air which a Chinese plays has cost him the labor of many months to learn; and so tiresome is this acquisition, that the author has heard some extemporize very prettily without being able to play a single air. Their performance, however, is very graceful; and though the melody be simple, every scope is given to variety by the mode of touching the strings. The author enters into an examination of the musical theory of the sounds produced by this instrument. Ibid

Carbolein.—This name has been given to a new kind of fuel recently invented by a Russian, M. Weschinskoff, the manufacture of which is thus described in the Moniteur Industriel :—" It is composed of coal, or of any other combustible, pounded as fine as possible, and mixed with a sufficient quantity of animal or vegetable oil. This mixture is subjected to a strong pressure, in order to produce pieces as hard and solid as stone. From an equal weight this carbolein yields five times more heat than common coal of the best quality. The flame which it produces is very bright, and burns for a long time. This property will render it extremely valuable in founderies, in the manufacture of arms and in glass-works, &c. In short, it will be useful for all purposes where it is important to obtain quickly a hot and continuous fire. It appears from the results of its use on the steam-ship *Sirius*, that the paddle-wheels which made twelve revolutions in a minute with the best coal, made nineteen in a minute when carbolein was used. This new combustible appears then to be very useful, and deserves that further experiments should be made in order to ascertain the accuracy of the results, which are stated to have been arrived at in the experiments already made."

Improved Piston and Valve.—Messrs. George Holworthy Palmer, and Charles Perkins, have obtained a patent for improved constructions of pistons and valves, for retaining and discharging liquids, gases, and steam. The first part of this invention consists of an improved piston, which may be likewise used as a valve. It is composed of an elliptic plate of metal, the minor diameter of which is the same as the inner diameter of the barrel or cylinder in which it works, but its major diameter is one-fourth larger. On the major diameter near its centre is an adjustable knuckle or joint, to which the piston rod is secured by any suitable means, so as to admit of the piston swinging or adjusting itself freely in the direction of its major diameter, thereby enabling it to come into close contact with, or to " bed" itself at its periphery upon its " seat," viz., the barrel or cylinder in which it works.

If it is intended to be used as a valve, the knuckle or joint is removed, and it is screwed to an axis placed directly across its major diameter near its centre, and turning in bearings in the sides of the barrel or cylinder.

The second part of this invention consists of a double adjusting balancing valve.

It consists of a plate having two openings in it, one of which is closed by a valve beneath the plate, and the other by a valve above it; the valves are connected together by a bent arm, turning upon an axis placed mid-way between the two openings, so that on one valve being opened the other is opened also, and on one being closed the other is closed likewise.

The patentees claim the right of making or constructing the elliptic pistons or valves, of any one or more materials, in one or more pieces, and with any auxiliary precautions to insure their action under dif ferent applications, and also their application and use to various pur poses. And, as regards the double adjusting balancing valve, they clain the right of making, constructing, or forming the same, of any one or

more suitable materials, or of one or more pieces, and the application and use of them, under different modifications, to steam-boilers, steam-engines, pumps, &c., or other purposes to which they may be applied.

Ibid

Potash from Beet Root.—It is stated in a late number of *Le Fanal*, that molasses of beet root will yield 60 per cent of its weight of potash.

Improved Horse-shoe.—This invention consists of a jointed horse-shoe made in five pieces, so arranged that expansion may be allowed in the heels without throwing all the motion to the toe as in the ordinary jointed shoes.

The pieces consist of a toe-piece, an off-side piece, a near-side piece, and two conical rivets. The side pieces are joined to the toe-piece at the quarters by the two rivets, by which means the necessary expansion is given to the heels without distressing the toe.

New Apparatus for Working Pumps.—This invention consists in a mode of working pumps by means of a pendulum or moveable weight, attached to a bar or rod suspended on an axis or wheel, on which it vibrates after the manner of a pendulum, the motion of which is communicated to the pump or pumps by suitable mechanism. The motion is obtained by placing the machine containing the pendulum on a body in motion, such as the deck of a ship, or by keeping the machine stationary, and allowing the wind to cause the vibration of the pendulum; the stroke of the pumps in both cases being caused by the tendency which the pendulum has to preserve its perpendicular position. When the machine is stationary, the top of the pendulum-rod is provided with vanes, on which the wind acts, and causes the pendulum to move in one direction; the return movement of the rod after each vibration is caused by the weight of the pendulum, the vanes being, by a peculiar arrangement, feathered, or brought with their edges to the wind, at the end of the vibration.

Ibid

New Process of Case-Hardening Iron.—This invention consists in making the article of wrought iron (required to be case-hardened) red hot, and dipping it into cast iron in a state of fusion, turning it gently round in it, when the cast iron will completely case over it with any required thickness of cast metal, from $\frac{1}{16}$th to $\frac{1}{2}$ an inch, The wrought iron article, immediately on being taken out of the cast metal, is immersed in cold water, on taking it out of which, it will be found to be perfectly case-hardened or steeled.

New Method of Impregnating and Preserving Wood.—The log of wood or timber is placed in a trough in an upright position, and a flexible receptacle, such as a waterproof bag open at both ends, is secured on its upper end by means of a strap or band, drawn tightly round a groove, which is cut in the log within three inches of its top. Any of the chemical materials described below are then poured into the bag, until they rise to the height of a few inches above the top of the log. As the liquid penetrates downward from the top of the log, the sap runs out in a proportionate degree at the lower end, and the operation will be finish-

ed when the liquid that runs out from the lower end of the log is nearly of the same quality as that which is poured into the bag above. The liquid in the bag must always be kept at the height of a few inches above the top of the log.

The following are the materials with which the wood is impregnated :—For preserving and hardening the wood, the rough pyrolignite of iron in solution, of the strength of from three to six degrees, is employed; for preserving only, the chloride of sodium, of the strength of from five to ten degrees, is used. For giving flexibility and elasticity to the wood, and preventing it from warping, as well as preserving it against combustion, the chlorides of calcium and magnesium in solution, of the strength of from five to twelve degrees, are used; the mother waters of salt marshes may likewise be used with advantage for the same purpose. The drying of the wood is hastened by the employment of sulphate of soda in solution of the strength of from three to six degrees.

The wood may be dyed of different colors by the use of mineral or vegetable coloring matters, or by means of some animal snbstances.

Among the minerals a blue color is obtained by the successive introduction of prolignite of iron and prussiate of potash; yellow, by the employment of the acetate of lead and the chromate of potash; green, by the successive formation in the interior of the wood of blue and yellow.

Other colors are obtained by the use of sulphate of copper and prussiate of potash, the sulphate of iron and chromate of potash, the deutochloride of mercury and the iodide of potassium.

Some colors are also produced from vegetable substances, and also by the infusion or decoction of known coloring matters, such as logwood, French berries, &c.

Of animal solutions, the ammoniacal solutions of carmine and some other substances may be employed.

In order to impart a fragrant smell to wood, alcoholic solutions of essential oils and other odoriferous substances are made use of. Ibid

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Restoring Magnets.—Professor Muncke states, that a weakened magnet may be restored to its primitive power, by applying as many keepers as it can sustain, and adding others as its power returns, which under this treatment will be the case.

The Davy Lamp.—When Sir Humphrey Davy invented his safety lamp, it was at first supposed, that, with this instrument, there was no danger to the miner in an atmosphere highly charged with carburetted hydrogen; but experience has proved that such is not the fact—that this instrument is not always a safety lamp; but there is, fortunately, a mode of rendering it perfectly so. The practical miner, who often understood the matter better than most philosophers, would describe this gas at times as the "fire-blast"—as the sudden rushing-in of a large quantity of carburetted hydrogen, and, when that was the case, the lamp had no safety whatever. When a fatal accident occurred from such causes in a mine, we were in the habit of saying that the miner must have carelessly removed the wire-gauze covering; but that de-

gree of incaution was not necessary to produce an explosion. If we inject a stream of this explosive gas against one of the safety lamps, the wire would immediately melt, and inflammation or explosion follow. A very ingenious lamp had been contrived by a miner named Roberts, who passed round the metallic tissue in the centre a tube of glass or talc; the latter was best for the purpose, because it was not in danger of fracture from pieces of coal flying about. Above and below, Roberts placed three or four thicknesses of wire gauze; for it was found, that even two thicknesses reduced the danger, and three entirely removed it, of an explosion. But the lamp could not be enclosed at the sides with three thicknesses of the wire gauze, because then there would not be sufficient light for the miner, so the talc was used instead.

Prof. Partington.

New Process for Stereotyping.—The following notice of a discovery which has been made at Brussels is given in the *Fanal :*—" Nothing could be more desirable than a less expensive method of taking correct stereotypes from printing forms, in order to preserve the composition of many important works. The following is the very simple process that is used :—The whole of the printing form is covered with blackened wax, that is rather soft. The superfluous wax is scraped off with a wooden scraper till it comes even with the face of the letter, then a dozen waste sheets of paper are pulled at the printing press to remove the remaining superfluous wax from the face of the letters. When the paper thus pulled ceases to be blackened, it is a proof that they no longer touch the wax, and that that operation is finished. The form is then placed in the galvanoplastic apparatus. The copper is deposited, and a mould obtained in copper which will afterwards serve to cast the type metal in. The stereotype plate being nailed on a wooden cylinder, can furnish 20,000 copies a day by continued rotation. It must not be forgotten that the printing form must be covered with plumbago, which adheres to the wax, in order that the deposit of copper may be spread over all the form. This is made public to prevent any patents being taken out in Europe."

The Siberian Mammoth.—The almost entire remains of the mammoth in the British Museum were found in Siberia in 1799; it has a near resemblance to the elephant; some modern naturalists have asserted that it still exists in Siberia, but it has hitherto escaped all research. Its residence seems to have been confined to a line in the northern hemisphere, extending from Siberia to the river Ohio in the United States. The specimen from which these casts were taken when found, though not alive, was in a complete state of preservation, and from the power of the agent through whose action it was preserved, almost any date might be assigned to its antiquity. The following is the account :—

A Tonguse chief in the summer of 1799, when the fishing was over in the river Hena, repaired, as is usually the case, to the sea-side, leaving his family in their huts. He coasted along the shore in quest of the tusks of the mammoth, when in the centre of a large block of ice he saw a huge shapeless mass which did not at all resemble the logs of driftwood often found there. He could not, however, make out wha

it was, but returning to the same spot the following year, he observed that the mass which he had seen the year before was freer from ice, but that there were two similar pieces by the side of it: these proved to be the feet of the mammoth. In 1801, the side of the animal and one of its tusks were distinctly appearing; he acquainted his friends with his discovery; this created great commotion among all. An aged couple asserted that a similar monster had once been seen before, but that the family that had discovered it had soon become distinct; the superstitious report affected the health of the chief, and drove him from his prize; but on his recovery, he became more resolute, and determined not to relinquished the profit he might make of the tusks. It was not till five years after, that the ice became melted sufficiently to disengage the immense animal, when it fell over on its side on a bank of sand. The Tonguse was contented with the tusks, which he took away, and sold for goods of the value of 50 roubles (about £11); the carcase was left to the wolves, bears, and foxes. He had, however, made a rude drawing of it previously, which represented it with pointed ears, small eyes, hoofs resembling those of a horse, and a bristly mane, extending the whole length of the back. In 1808, Mr. Michael Adams, being at Zakoutsk, heard of the circumstance, and went to the spot. On his arrival, he found the skeleton was stripped of the flesh, but was itself entire, with the exception of one fore foot; the vertebræ, one of the shoulder blades, the pelvis, and the remaining three extremities were held together by the ligament of the joints and by strips of skin. It received some damage on its removal to St. Petersburgh, a distance of nearly 7000 miles; the ears were preserved, and the pupil of the left eye was perfectly distinguishable: it was a male, and had a long mane, but neither tail nor trunk; the skin was of a greyish color, and covered with red hair and black bristles; the weight of the head was 400 lb., the height of the animal was 12½ feet, the length full 18; the tusks were curved three-quarters of a circle; their position is different from those of the elephant, bending towards the body of the animal.

Tires.

Machine for bending the tire of Railway Carriage Wheels.—Described by Joseph Woods, Grad. of the Institution of Civil Engineers, at a late meeting of that body.

The usual mode of bending tire bars was by means of swages and hammers round a fixed mandril; after being welded, they were stretched on a cast-iron block formed of two semicircular pieces hinged at one point, and wedged apart at the opposite side; the hoops being heated were placed on this block, and by repeated blows driven into close contact with the mould.

Much difficulty was experienced in thus making up tires for large railway wheels, and the present machine was constructed for facilitating the process.

One end of the tire bar when heated is wedged into contact with one of four segments of a circle, of the required diameter, upon a cast-iron table, which is caused to revolve slowly; the pressure of a guide wheel at one side forces the tire bar to warp round the segments, and to form the circular hoop required; its ends having been previously scarfed, are then welded together.

The tire is again thoroughly heated and placed round the four segments, which slide radially on the table, and are then simultaneously forced outwards by a motion of the centre shaft.

The tire being slightly chilled, and assisted by the swage and hammer, soon adapts itself to the segments, and forms a circular hoop instead of two semi-circles irregularly joined at their points of contact, as by the old system, it is then ready for being chucked on the lathe, and bored out before shrinking on the wheel.

It is apparent that a machine of this description becomes applicable to tires of any diameter, by having three or four sizes of segments adapted to the table. It is found to diminish the manual labor, and to prepare the tire more accurately than by the usual process.

A model of the machine, and a detailed drawing of the several parts accompanied the communication.

Curious Effect of Lightning on Glass.—The Maidstone Gazette states, that during a thunder storm in that neighborhood last week, when several haystacks were fired, and much other damage was done, one flash of lightning, after striking a chimney and the tiles of a pipe manufactory, was partially dispersed, and reflected against the dwelling-house opposite, the four windows of which facing the chimney, and at about 15 or 20 feet distant, present a very singular appearance. In several panes oval blisters have been raised like the air-bubbles seen in badly-mannfactured sheet glass. When first observed, they were covered with a fine dark-colored powder, which was unfortunately brushed away without being minutely examined, and there is a similar appearance inside some of the blisters. When the pipe manufactory was struck, four men at work were knocked down, and were of course dreadfully alarmed.

The dark-colored powder was probably manganese. Among the ruins of a fire which occurred in Gold-st. two or three years since, a quantity of glass was found with a dark brown coating upon its surface, which proved, upon examination, to be manganese. The glass had undergone partial fusion; its transparency was destroyed, and the manganese precipitated to the surface.—*Ed. Rep. Em.*

Setting out Curves for Railways.—At a recent meeting of the Institution of Civil Engineers, a communication "On setting out Curves for Railways," by R. C. May, Associate, was read.

The method here proposed of setting out curves is founded upon the 32nd Prop. of the 3rd book of Euclid. It consists in cutting off by a chord a segment of the circle to be described, and then finding any number of points in the curve by means of a reflecting instrument, which is set so as to reflect the angle in that segment.

The instrument which has been adapted by the author for this operation, consists of two plane mirrors, the upper one being fixed vertically upon a disc of brass, and the lower one fastened to an arm which turns upon its centre, and permits the two mirrors to be set at an angle with each other: the arm can be fixed by a clamp screw. In the case sur-

rounding the mirrors are two holes, for admitting light, and between them is the sight hole, placed so as to bisect the angle formed by the mirrors. From the underside at the centre of the instrument is suspended a slender wooden rod, with a pointed end, weighted with lead.

Angles are taken with the instrument in the same manner as with the box sextant. To determine any point in the curve, the instrument when set fast is placed in such a position that the two given objects coincide in the mirrors, and the weighed rod being released by withdrawing a bolt, falls directly beneath the centre of the instrument, marking the required point in the curve.

The author presented with this paper a reflecting instrument and field tables of chords and segments, to be used in setting out curves by this method.

A New Paving.—M. Polonceau, the engineer of Paris, proposes a new mode of paving for Paris, consisting of artificial stones made of clay, sand, and pulverized charcoal. This mixture stood heat well, and became vitrified; it also dried without cracking. The stones were made in a hexagonal form, and could be put down or taken up one by one. The government had given leave for an experiment to be made of this system in one of the streets of the capital.

British Exploring Expedition.—The following letter, dated the 17th of April, 1841, at Hobarttown, received at Lloyd's, contains the fullest account we have yet seen of the progress of our expedition to the South Polar Sea:— Athenæum

By the last list you will have perceived the return to this port of her majesty's ships Erebus and Terror, captains Ross and Crozier. Nothing official has as yet transpired here; but it is generally understood that the expedition has been very successful, and these British ships proceeded 11 degrees lower south than the Astrolabe and Zélée, and four degrees more than any other vessel has ever yet reached; that they were enabled to fix the exact position of the south magnetic pole at about 100 miles distant thence; and that some extraordinary mistake appears to have affected the calculations of the Americans, who approached these regions. The Erebus and Terror entered the main part of the ice, on their voyage of discovery towards the south pole, on the 5th of January last, being then in latitude 66 45 S. and longitude 174 13 E. On the 10th of the same month they descried land in lat. 71 56 S. long. 171 17 E.; and coming up to it on the 12th of January, they took possession of it in the name of her majesty. This land extends south to degree 79. Proceeding onwards, a large volcano, emitting dense clouds of smoke, was observed on the 28th of January, in lat. 77 31 S. long. 167 30 E. On the 2d of February they reached to the utmost extent of their voyage, viz. lat. 78 4 S. and long. 173 12 W. and were here stopped by icebergs 150 feet high, and by fields of ice which were traced as extending 300 miles to the eastward. The expedition penetrated about four degrees further south than the American or French discovery vessels; and although in the course of the voyage it was enabled to verify the correctness of many of the spots laid down in the charts of the former, they also discovered one singular error—

namely, the existence of water over a large space described as land, and which the Erebus and Terror actually sailed over for a very considerable distance, leaving the land 300 miles from the latitude laid down in the American chart. It is said that the sea in this direction abounds in seals and sperm whales. Not a single casualty occurred among the crews, and the vessels reached Hobarttown in safety, where they will remain till the season arrives for further operations. The result of the attempt already made has been highly satisfactory, the vessels having got within what was supposed by the indication of the needle to be 100 miles of the magnetic pole.

Fine Arts.—Thorwaldsen has been banqueting with the distinguished citizens of Munich, and taking honors from the Bavarian king. The latter include the Grand Cross of the Order of St. Michael.—Letters from the same capital mention that the Duchess of Placentia, who has for the last ten years resided in Greece, has induced the government of that country to incorporate the Academy of Design and Painting, founded by her last year, with the Polytechnic School; and that king Otho, with a view to rendering the latter institution as effective as possible, has commissioned its Director, the Col. Zeutner, to visit all the similar institutions in England, France and Germany, for the purpose of studying their organization, and introducing such amelioration as these might suggest.

The well-known Aulic-counsellor André, of Offenbach, who, forty years ago, purchased from the widow of Mozart all the autograph musical manuscripts of the great composer, has resolved—so the journals tell us—on publishing all such as have not yet been given to the press; comprising about 280 distinct works. Amongst these, seven operas are mentioned. There are, also, the score of a ballet intended to be introduced into the opera of "Idomeneo, re di Creta'—overtures, choruses, &c., for the Baron de Gobeler's drama, entitled "Thamos"—several symphonies for a full orchestra, and a great number of concerted pieces for a variety of instruments. Cor. of Atheneum.

Mechanical Science.—The following are a few of the reports in the Atheneum upon subjects brought before the sections on Mechanical Science and Chemistry of the British Association at its meeting for 1841.

On Truscott's Plan for Reefing Paddle-Wheels..—Mr. Chatfield described, by reference to a model, an improved paddle-wheel, the principal feature of which was a new application of the principal of feathering and reefing. Each paddle or float is attached to an axis passing through its centre, with a crank at the extremity of the axis, and the feathering is effected by the motion of a roller attached to this crank, and moving in a groove eccentric to the wheels. The radii of paddle-wheel are connected at their extremities by a chain instead of a rigid rim, and the reefing is effected by drawing the radii together, like the folding of a fan, by means of a peculiar arrangement of the clutch box at the centre of the wheel.

On a Plan of Disengaging and Reconnecting the Paddle-Wheels of

Steam-Engines, by J. Grantham.—There are four cases in which it may be desirable to disconnect the paddle-wheels from the steam-engine in steam vessels, viz. when the vessel is on a long voyage, and the fuel must be economized as much as possible by using the sails on every favorable opportunity; when the engines are damaged, and the vessel being close to a lee shore, it is necessary to disengage the engines quickly, to allow the vessel to make sail; when some derangement has taken place, and the engines are allowed to continue to work imperfectly to the end of the voyage, rather than detain the vessel by causing the paddles to drag through the water while the engines are stopped; when, the vessel being at anchor, the action of the swell and tide on the paddle floats, while stationary, causes a great additional strain on the cables, which would be obviated could the wheels play freely. The Admiralty had called attention to the subject, by inviting plans for effecting it. Several had been proposed for disconnecting the paddles, but Mr. Grantham is not aware of any plan having been proposed by which the wheels could be readily reconnected in a heavy sea. The crank pins are usually fixed in the cranks of the intermediate shaft, a little play being allowed in the eye of the crank of the paddle shaft, to prevent the crank pins from breaking when the centres of the three shafts vary from a straight line by the yielding of the vessel. For the purpose of disengaging and reconnecting, a brass box of a rectangular form is inserted in the eye of the crank of the paddle shaft, which can be moved several inches by means of a screw at the back of the crank. The eye of the crank is so made that two of its sides may be cut away, and through these openings the crank pin can pass when the box is drawn back, or the disengaging effected. The brass box has one of its sides, which restrain the crank pin when in gear, cut away one or two inches to assist in reconnecting the engine, which is effected by screwing the box out one or two inches, or just so far that the crank pin can pass the side which has been cut away, and come in contact with the higher side. This is the correct position for reconnecting, which is accomplished by a single turn of the screw.

Mr. Grantham, in reply to a question from Capt. Taylor, R. N., stated that he should consider it very dangerous to disconnect the paddle-wheels without first having stopped the engine.

Mr. Scott Russell reported the progress made by "the Committee on Forms of Vessels" during the past year. The object of the experiments is twofold—to advance our knowledge of the laws of resistance of fluids,—and to obtain data for the practical improvement of the art of naval construction. Many and expensive are the experiments formerly made on this subject. Unfortunately, these experiments had been made with imperfect apparatus, or under circumstances different from the conditions of bodies moving on the surface of the water, or on solids of a form unsuitable to the formation of ships, or on so small a scale as to render them unworthy of the confidence of the practical constructor. In the present series of experiments a more simple apparatus was employed than in any former series of experiments. The forms of body experimented upon were those of actual ships, or bodies analogous to those in use; it was the object of the experiments to supply the actual desiderata of hydrodynamics and of practical ship-

building. The experiments were made on vessels of every size, from models of 30 inches in length to vessels of 1,300 tons. The experiments were also made upon vessels in water of variable depth, and in channels of various dimensions, so as, if possible, to embrace all the elements of the resistance. A minute description of some of the apparatus was then given, along with some general illustrations; but as the experiments were still in progress, and to be continued during the following year, no general statement of results was entered into at the present meeting. It was expected that by the next meeting the whole would be concluded.

On an Improved Sight for Rifles and other Fire-arms, by C. Thornton Coathupe.—The usual mode of constructing the regulating sight of a rifle is, to adapt a piece of steel to a dove-tailed groove, filed transversely across the lower end of the barrel, and to furnish this with movable leaves of various heights, which are adjusted for certain definite ranges, as 100, 150, 200, 250 yards, but between these stated intervals an imaginary estimate for the correct elevation must be made. The following sight is equally simple in construction, and any elevation may be obtained with accuracy. A piece of iron plate, square at the edges, of from six to eight inches in length, and from $\frac{3}{8}$ to $\frac{1}{2}$ an inch in width, about $\frac{3}{8}$ at its thicker, and $\frac{1}{16}$ of an inch at its thinner end, is fixed to the barrel by screws. Upon this inclined plane is fitted a piece of steel of similar length and width, and of uniform thickness throughout, with a sight in its upper edge, movable in a dovetailed section of the preceding piece, so as to traverse the inclined plane from end to end. If the upper edge of this traversing sight, when at the commencement of the inclined plane, be so adjusted to the heights of the inclined plane and of the muzzle, that a line passing through a central point in each shall be parallel to the axis of the bore, this will be the position for the point blank range of the rifle; and as the lower sight is pushed gradually along the inclined plane, the angle of elevation, and consequently the range, will be proportionally and gradually increased until it has traversed the extent of its limit, and the lower plate being graduated for every ten yards of the range of the barrel beyond its point blank range, the sight may be instantly adjusted by means of the thumb, to accord with the estimated distance of the object from the observer.

Report of the Committee, consisting of Prof. Moseley, Mr. Enys, and Mr. Eaton Hodgkinson, for applying a Principle of Dynamometrical Admeasurement, invented by M. Poncelet, to the construction of a Permanent Indicator for Steam-Engines.

The registration of the work done by the steam at the piston of a steam-engine, is a most important practical question, being applicable to every variety of engine, and showing the absolute work, independent of friction and other resistances, to which the working parts are subject. The advantages which have resulted from the accurate knowledge of the duty in Cornish engines, are well known. The registration effected in these engines was comparatively easy, from the constant nature of the work which is performed; and the invention of a method which can be extended to all engines, whatever the nature of the work upon which they are employed—whether fixed engines or locomotives

—was a question of sufficient importance to justify the appointment of a committee by the British Association, and the placing a grant of money at the disposal of that committee. The only instrument at present in use is the Indicator of Watt: on the insufficiency of that instrument for the purposes contemplated it is unnecessary to dwell. The principle of dynamometrical admeasurement first proposed by M. Poncelet, and described in his "Mécanique Industrielle," and in M. Morin's "Description d'Appareils Dynamométriques," seemed peculiarly adapted for the objects in view. The application made by M. Morin was to an instrument for registering the work done by a team of horses dragging a loaded carriage. Two strong springs are fastened together at their extremities, and the separation produced in these springs by the traction of the horses—which separation is, within certain limits, always proportional to that traction—furnishes the means of measuring the tractive force exerted. (The Report then proceeds to describe, by reference to drawings, the construction and action of the apparatus.) The motion of a certain wheel during any finite time, is proportional to the sum of the products of each elementary space described by the carriage, multiplied by the particular force of traction under which that elementary space is described, so that the whole space moved over by this wheel is directly proportional to the whole work, or dynamical effect expended in moving the carriage over that space, however varied the traction or the velocity may have been. The principle which combines the motions in the machine is, in fact, the complex operation known in analysis as integration. The design of the Indicator was given by Prof. Moseley, and its execution placed under his direction. An alteration of considerable importance in the mechanical construction was made at the suggestion of Mr. Dutton, of Manchester, and the instrument, in its present form, was placed on the engine of Messrs. Fairbairn & Murray, at Mill Wall, and answered all the mechanical functions assigned to it with entire precision and accuracy. During the ensuing year the committee will proceed to apply the Indicator to the engines whose work is registered by other means, and to compare the two registrations, and hope to be enabled to lay before the next meeting of the Association a considerable accumulation of results, obtained by trials of the instrument under a variety of different circumstances.

On a System of Trussing for the Roadways of Suspension Bridges.—Mr Rendel placed before the Section a model of the Montrose Suspension Bridge, the roadway of which had been recently restored, and a peculiar system of trussing adopted. Suspension bridges were peculiarly subject to undulatory motions, which proved extremely destructive to them. These undulatory motions arise from the action of the wind, and the circumstances are such that the wind may tend to raise the roadway at one end, and depress it at the other; and various means had been devised to prevent these motions. In 1838, a considerable portion of the roadway of the Montrose bridge was destroyed, and Mr. Rendel being employed to restore it, it struck him that, if great stiffness were given to the roadway by a system of longitudinal trussing, the desired object would be attained. He adopted, therefore, a system of vertical and longitudinal trussing, extending above and below the line of the roadway, so that the neutral axis of the truss is in the roadway.

This had succeeded most completely. In an ordinary gale of wind, the original roadway would be subject to a wave of from three to five feet in height; but he was satisfied that the present roadway is not subject to a wave of as many inches. The weight of the roadway has not been increased by more than five or six per cent.

Improved Method of Preparing Phosphorus.—By the usual method of preparing this substance, which is of great importance in the manufacture of lucifer matches, so many gases are at once disengaged that there is much danger from explosions. In order to avoid this inconvenience, the mixtures of phosphorate of lime, charcoal and some parts of sulphuric acid should be well heated in a copper vessel, the bottom of which has been previously heated to redness. This temperature will be sufficient to drive off all the water, which usually amounts to 10—15 per cent. By this means much less phosphuretted hydrogen is evolved. It is best to mix at first only about 1 per cent. of charcoal with the phosphate of lime, and only after having heated the mixture to redness—to add the remainder of the ignited charcoal in order to volatilize the water and the sulphuric acid; because if it is added all at once, the water begins to volatilize at the time when the phosphorus is disengaged. By this plan, very little phosphuretted hydrogen gas is emitted, the phosphorus produced is much more pure than that of commerce; and the second distillation is no longer necessary, since the oxide of phosphorus which remains can be readily decomposed into pure phosphorus and phosphoric acid by treating it with dilute nitric acid at the temperature of 140° to 158°.

Electrotypes.—From Munich, it is stated, that the sculptor Stigelmayer has succeeded in perfecting his galvano-plastic process—obtaining in his work-rooms, results the most extraordinary, which he has since submitted to the public inspection of the artists and amateurs of that capital. In the space of two or three hours, colossal plaster statues are covered with a layer of copper, presenting the nicest details with extreme delicacy, and giving at the same time all the solidity of appearance belonging to similar figures cast in bronze. The same process has been applied to small objects, such as flowers, plants and insects; and the metallic covering renders all the delicacies of form—so it is said—with a fidelity as exact as if they had been executed by the hand of an artist.

Herculaneum.—From Naples, it is stated, that the government has resolved upon undertaking new excavations, on an extensive scale, at Herculaneum and in its environs. With this view, negotiations are are already commenced for the purchase of various estates in the neighborhood; and the works will be commenced so soon as these shall have become the property of the state. The minister of the interior, in conjunction with the Royal Academy of Sciences, is to appoint a commission of archæologists and architects to preside over the excavations. To this piece of Neapolitan intelligence, we may add the announcement, on a kindred subject, that the Chevalier Zahn, who, for the last seven years, has been exclusively employed in copying the most re-

markable of the paintings found in Pompeii, is about to publish his collection, at the expense of the government. To these engravings the Chevalier applies a new litho-chromatic process, invented by himself, enabling him to make use of oil colors; and the early proofs of four of his plates, obtained by this method, are now exhibiting to the public, and attracting much admiration.

DESCRIPTION OF AMERICAN PATENTS

Granted from July 30th to Aug. 8th, 1841.

Improvement in machines for Planting Cotton Seed. By R. S. THOMAS, Bennetsville, S. C. July 30th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the manner of constructing the seeding roller with alternate ridges, or points, and excavations for the reception of the seed to be planted; the ridges or points operating as agitators to keep the seed in motion, and cause it to fall into the excavations. I am aware that agitators have been frequently used within a hopper in seeding machines, but these have been constructed in a manner much more complex than that employed by me, which method is perfectly effective and simple, not requiring any additional moving parts, the rear part A′ being hinged to the forward portion in the manner described, and for the purpose of covering the seed that has been planted; and this I claim in combination with the ridge or keel-piece for forming and preparing the furrow, said keel-piece extending along the bottom of the bed-piece.

I also claim the forming the bearing of the hopper upon the planting roller, by means of a piece of leather or other elastic material, in the manner set forth.

Improvement in the construction of Grates for Lime Kilns. By WILLIAM B. HILL, Bellevue, Eaton county, Mich. July 30th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the forming the combined bars or fire supports, arranged and constructed as described, in part of metal and in part of fire-proof earthy compound, substantially in the manner and for the purpose set forth; and the combining of said compound fire supports with each other by means of a suitable frame, and of a rod or bar, to which the swinging edges of each of them is jointed, as described, for the purpose of opening or closing them in any required degree, by which means the draught may be regulated, and ashes or other matter may be readily discharged.

Improvement in the art of Distilling. By SAMUEL OLIVER, Northampton, Pa. August 4th.

CLAIM.—What I claim as my invention, discovery, and improvement, and desire to secure by letters patent, is the application of wood ashes, ley, or potash to the process of distillation of rye, corn or other grain into whiskey or alcohol, for the purpose of retarding the acetous fer-

mentation and increasing the yield, using the above specified quantities, or increasing or diminishing them as circumstances may require.

Improvement in Scythes, relating to the mode of Fastening the Thole or Handle upon the Snath. By SELAH W. FOX and ARETAS FERRY, Bernardston, Mass. August 4th.

CLAIM.—We shall claim as our invention, constructing the clamp ring of the thole with a spring washer on the interior of the same, and combining the said clamp ring with a shank firmly fixed in the handle, and having a male screw at one end, which engages with a corresponding female screw in the lower and shaped part of the clamp ring; the whole being constructed and operating together substantially in the manner above described, and for the purpose of firmly confining the handle to the snath.

We also claim forming the shank which is inserted in the wooden handle, with a shoulder *b*, as represented in Figs. 5 and 6, and as above described, by means of which the shoulder operates to press the collar against the snath, and draws the clamp ring down upon the opposite side of the same, independent of the wooden part of the handle; the whole being for the purpose herein above specified.

Improvement in the mode of Hardening Steel. By PERRY DAVIS, Fall River, Mass. August 4th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the mode of hardening steel so as to render it flexible, by means of the composition of oil, and charcoal, and borax, as set forth.

Improvement in the method of propelling Boats. By MEREDITH MALLORY, Urbana, N. Y. August 4th.

CLAIM.—Now, what I claim as my invention, is the applying the water lifted or thrown up by the paddle-wheels of steamboats, so as to produce an auxiliary propelling power, in the manner before described, or in any way analogous thereto.

Improvement in Ornamental Slides or Plates for covering the Flues of Stove Pipes. By PERRY DAVIS, Fall River, Mass. August 8th.

CLAIM.—What I claim as my invention, and which I wish to secure by letters patent, is constructing the perforated plate with collar around the aperture to adapt it to the hole made by the stove pipe, in combination with the slide covering said aperture, as set forth.

Abridgment of the Specification of a Patent for an Improved Marine Steam Engine. By CHARLES W. COPELAND, New-York.

To all whom it may concern, be it known, that I, Charles W. Copeland, civil engineer, of the city of New-York, in the state of New-York, have invented certain improvements in the manner of arranging the low pressure or condensing steam engine, and of certain parts thereof, so as to adapt them in an especial manner to steam frigates, and to other

vessels intended for ocean service; and I do hereby declare that the following is a full and exact description thereof.

The principal objects which I have in view, and which I have attained, by my new arrangements of the steam engine, are, first, the ability to place an engine, having any desired length of stroke, on board of a vessel, without regard to the depth of such vessel. Secondly, the simplifying of some of the working parts, in such manner as to cause the engine to work with greater efficiency; the direct action of the steam being employed in situations where a series of levers and connecting rods have heretofore been used, in consequence of which new arrangements the friction, and the liability to derangement, are lessened. Thirdly, greater security from injury to the machinery, on board of vessels of war, by the location of the principal working parts of the engine below the water line, and consequently out of the reach of shot. Fourthly, the facility with which all the working parts may be approached, when the engine is in operation. Fifthly, a diminution of weight, when compared with marine engines of the same power, as ordinarily constructed and arranged; and in consequence of this, and of the simplification of the parts, a diminution in the first cost of the engine, and in the keeping it in repair. And lastly, the greater strength allowed the vessel, in consequence of the leaving a larger number of the deck timbers undivided, than under the usual arrangement of engines on board of sea vessels.

[The following description is an abstract of that contained in the specification, such parts of the latter as were not new, and only comprehensible by reference to drawings, being omitted.]

The engine is supported upon the kelsons, which are to be firmly fastened to the frame timbers of the vessel. The frame work of the engine is secured to the kelsons, or through the ship's frame, as usual, by bolts.

The steam cylinder is placed obliquely, and the respective parts of the apparatus are made to conform to this obliquity. The angle at which the cylinder should be placed must be determined by the length of the stroke and the depth of the vessel, and will be dependent therefore upon these circumstances. The piston rod and the rod by which it is connected to the crank, the shaft of the propelling wheels and the pillow block which supports it, are the same as the like parts of the engine in common use. The valves in the steam chests may be either balance or single poppet valves, as may be preferred: the valve stems are worked directly by the action of the rock shaft, on the feet attached to them.

The side pipes connecting the valve chests; the rock shafts, the levers attached to, and the rod connecting them; and the eccentric pin to which the rod is attached for working the valves, do not differ essentially in their arrangement and construction from the like parts in the common engine, except that they are made to suit the peculiar arrangement of the steam chests.

The air pump is placed at the same angle, or nearly so, as the steam cylinder; the arrangement of the air pump and its appendages with the condenser and channel plate, being new, and suited to the general

arrangement of the engine. A lever beam, which is operated upon by the cylinder crosshead, is used for working the air pumps. The feed pumps for supplying the boiler are fastened to the air pump, and are worked by its crosshead.

Instead of working the valves of my engine by the intermedium of lifting rods, in the usual manner, I omit the lifting rods entirely, and attach feet directly to the valve stems, and against these feet the toes of the rock shaft operate. By this manner of arranging the parts concerned in working the valves, I obtain a more direct action on the valves than heretofore, and that by means which are peculiarly simple and convenient.

In my air pump I use a solid piston, and I attach the lower end of said pump directly to the end of the channel plate. I also place the delivery valve, leading into the reservoir or hot well, on the upper side of the channel plate. By this arrangement of the air pump, of the channel plate, and of the valve, and hot well, the motion of the water is rendered more direct than under any other known arrangement of these parts, and the apparatus is also specially adapted to the particular manner in which the cylinder and the other parts of the engine are arranged.

Having thus fully described the manner in which I arrange and combine the respective parts of my engine, so far as the same is novel in its character, what I claim as new, and as constituting my invention, is, first, the placing the cylinder in an oblique direction, with the lower end near to the bottom of the vessel, and allowing it to stand at such an angle as is required for the connecting of its piston rod with the crank, on the shaft of the paddle wheel, for the purpose set forth. I do not claim the mere placing of the cylinder of a steam engine obliquely, as this has been done for other purposes; but as I produce a new and useful effect by so placing the steam cylinder and its appendages, on board of vessels for navigating the ocean, I limit my claim to the so placing them as to attain the objects herein fully made known.

Secondly, I claim the manner of arranging and working the steam and exhaust valves, as set forth; the same being effected by a direct action, that is to say, without the employment of the lifting rods and lifters usually required for that purpose.

Thirdly, I claim the manner of combining and arranging the condensing apparatus; the air pump being placed at the same angle or nearly so, with the cylinder, and attached by its lower end to the channel plate; the delivery valve being also placed on the upper part of said plate, as herein described and represented.

Specification of an Apparatus for producing adhesion between the Wheels of Locomotive Steam-Engines and the Rails of Railway Tracks. By JORDAN L. MOTT, New-York.

To all whom it may concern. Be it known, that I, Jordan L. Mott, of the city of New-York, have invented a new and useful method, or apparatus, for the purpose of producing adhesion between the wheels of locomotive steam-engines and the rails of railway tracks, by which device such engines will be enabled to overcome the slipping of the

wheels consequent upon oil, ice, &c., upon ascending grades, without its being necessary to throw any additional weight upon the wheels for that purpose. And I do hereby declare, that the following is a full and exact description thereof.

My improvement consists in the combined application of moisture and of sand, or other grit to the wheels, by means of which the sand may be distributed over the surface of the tire, or tread of the wheel, and will be made to adhere with sufficient force and in sufficient quantity to produce the required adhesion. In the accompanying drawing,

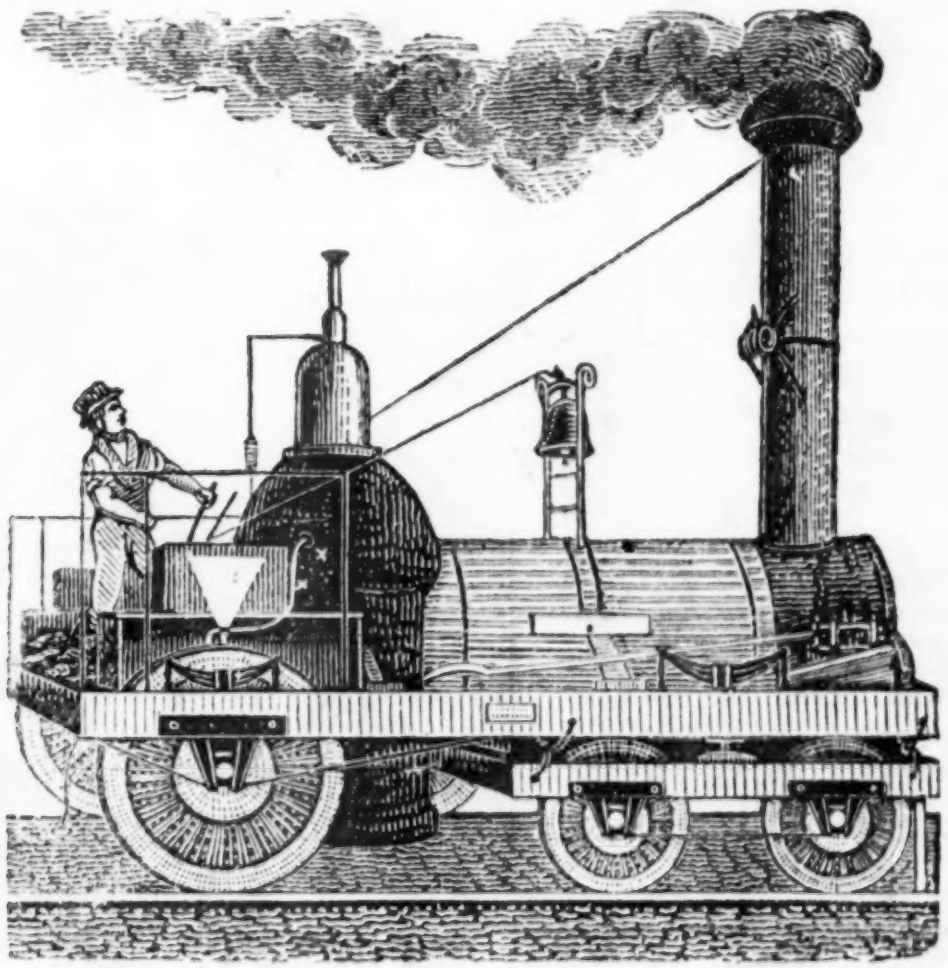


Fig. 1.

Fig. 1, is a perspective representation of a locomotive engine and carriage, having two driving and four truck wheels, to the former of which my apparatus is applied; its application, however, is not limited to locomotives of any particular construction, but is equally adapted to those with four, six, or eight driving wheels. Fig. 3, is an end view, and Fig. 2, a side view of such part of a locomotive as is requisite to to show the manner of applying my apparatus. A is the steam-chamber, and B the body of the boiler, which may be constructed in any of the ordinary forms. CC are hoppers or boxes for containing sand; the lower portions S, of which boxes are to be charged with this material in a dry state. These hoppers may be varied in situation; but I in general place them directly over the centres of the driving wheels; the sand is to be discharged from them through a tube or opening at their lower ends, which opening is governed by a valve or sliding shutter, by which it can be properly regulated. *a* represents the handle of such a valve or sliding shutter, which may be constructed

and managed in any of the known ways of constructing and managing devices of this kind. D, D, are steam or water-pipes, which are to convey the moisture to the wheel from the steam-chamber, boiler, or other source. These pipes are to governed by a stop-cock, as shown at *c*, *c*, and they discharge the water or steam on to the periphery of the wheel, and moisten it directly in advance of the aperture for the discharge of sand. If steam is used, it will be condensed upon the wheel; but it will probably be found to economize heat by using water; the quantity expended in either case, will not, however, be important in amount.

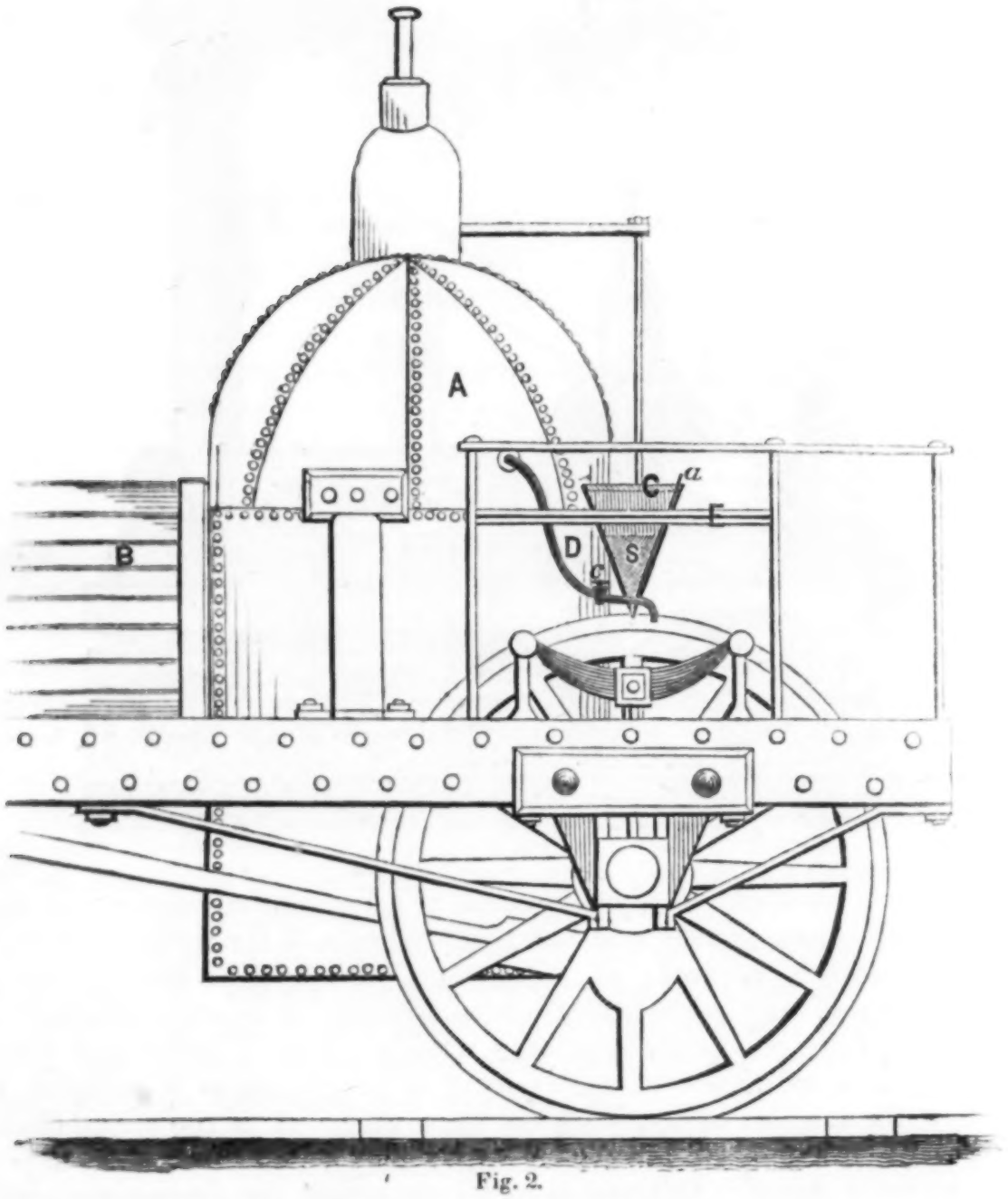


Fig. 2.

Instead of using water or steam from the boiler, water may be conducted through the pipes from a cistern or reservoir of cold water placed in any convenient situation for that purpose. Although I prefer to discharge the sand and moisture upon the *wheels*, it will be manifest that they may be directed with like effect on to the *rails* in advance of the driving wheels, and that the combined operation of the moisture and sand will be the same; but the apparatus will, in this case, have to

be extended without producing corresponding advantage.—Having thus fully described the nature of my invention, and shown how the same may be carried into operation, what I claim as new, and desire to secure by letters patent, is the applying of sand to the peripheries of driving wheels of locomotive engines, in combination with the application of water or steam to moisten the wheels, for the purpose of causing the sand to adhere thereto substantially in the manner set forth, and so as to enable such locomotives to ascend inclined planes or elevations on a rail-road, in consequence of the friction produced by such application.

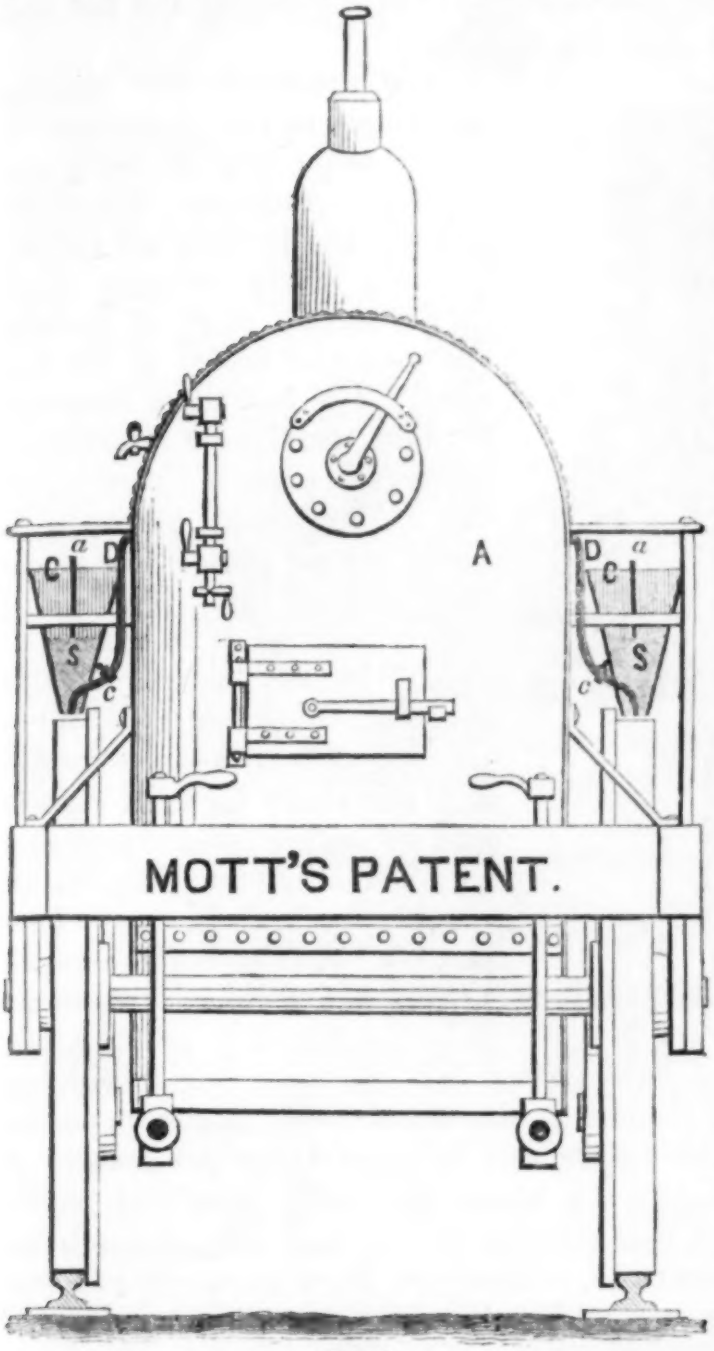


Fig. 3.

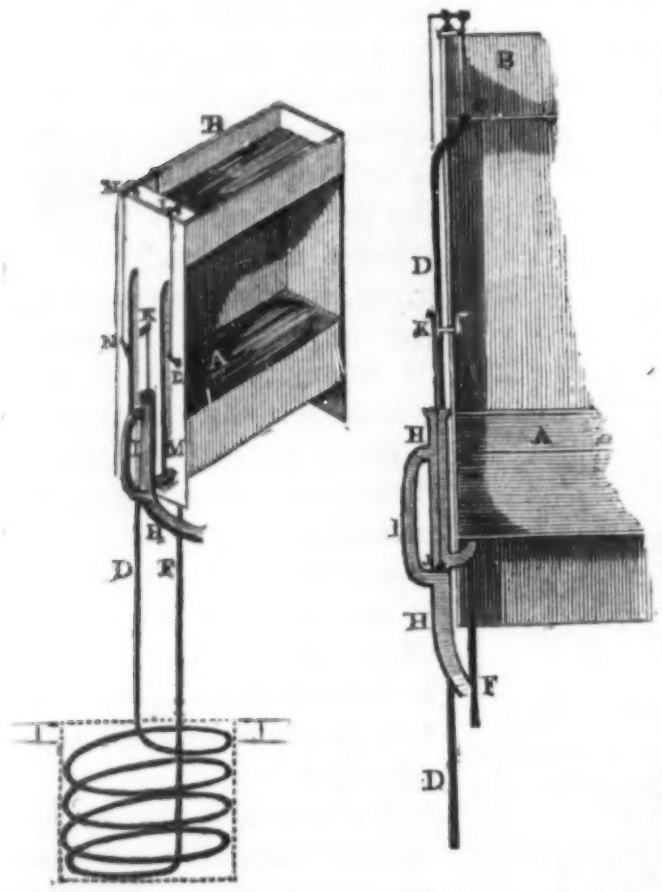
I claim also the applying of moisture and sand simultaneously to the tops of the rails in advance of the driving-wheels, by means of the apparatus herein described, considering this mode of applying the moisture and sand as a mere modification of the general principle upon which the utility of my invention is dependent.

Specification of an improvement in Bathing Apparatus. By GEORGE J. BYRD and PETER MILNE, New-York.

To all whom it may concern. Be it known, that we, George J. Byrd, and Peter Milne, of the city and county of New-York, and State of New-York, have invented a new and improved mode of constructing hot and cold water bathing apparatus; and we do hereby declare, that the following is a full and exact description thereof.

The nature of our invention consists in providing the bathing tub with a compound standing pipe, as shown in the drawings; the said standing pipe being so arranged as to admit hot and cold water through one aperture into the bottom of the bathing tub, and also to convey the waste water off through the same aperture, so that there is but *one* opening in the bathing tub whereby the hot and cold water enters, and by which the waste water escapes. And there is also combined with

this said standing pipe an *overflow* pipe, which, in every instance, will prevent the bathing tub from overflowing, even supposing the hot and cold water valves were left open by accident.



We construct our bathing apparatus, as per drawings, or in any other way or form best suiting the situation. We usually place the bathing tub (which is made in the ordinary way) in the second story of houses, and a copper boiler in the kitchen. We provide a reservoir to hold a sufficient quantity of water, and place it directly over the bathing tub, elevating it about six or seven feet above said bathing tub. This reservoir is marked B in the drawings. In the bottom of this reservoir there are two valves opening upwards—one for hot and the other for cold water; said valves are opened and shut by means of the handles or cranks, marked K (with copper wire connecting the same) in sectional drawings. The lead pipe D extends from said reservoir down to the boiler of water in kitchen, and coiled in said boiler about 100 feet, and returns to, and is branched into the compound standing pipe, or to that branch of it leading to the aperture G, as shown in the drawings. The valve on the upper end of pipe D, at the bottom of reservoir B, when opened, lets the water into said pipe, and passes through the coil E in boiler, and returns to the bath hot, through the pipe F, entering at the aperture G. The pipe D, with the coil E, and the ascending pipe F being one, and the same pipe continued; and it being an ascertained fact that water will always find its own level, so in this case the reservoir before described stands six or eight feet above the bathing tub; and consequently when the water is let into the pipe, it must rise and flow into the bathing tub. Again, the pipe M, leading from the other valve in the aforesaid reservoir, extends from the same *directly* to the compound standing pipe connecting with the same, or to that branch of it leading to the aperture G, as before described; this pipe supplies cold water to the bath; this pipe will be seen in the model, and, if I mistake not, in the drawings also.

Again, we place the waste water valve J in the aforesaid compound standing pipe between the branch of the same which leads to the aperture G, and the lower branch of the overflow pipe I; this valve also opens upwards; the situation of this valve will also be seen by reference to the model or drawings; this valve is also opened and shut by means of one of the cranks or handles marked K, in the same manner as the hot and cold water valves. So that we have three lever cranks or

handles; on one engraved *hot*, another *cold*, and on the third *waste*, and placed parallel to each other, in a convenient manner to be worked, there being also a point indicating *open* and *shut* engraved on the same.

As it regards the size of the aforesaid compound standing pipe, as a general rule, we make its calibre about six times larger than the hot and cold water pipes which are branched into it, consequently it cannot overflow, even supposing both pipes being let run at the same time. The bathing tubs are generally about twenty-two inches deep, and we place our compound standing pipe at the foot, the overflow of the same extending to within four inches of the top; but it is never intended to fill the bath to that height before getting into it. About fourteen inches of water is always sufficient in a bath for ordinary sized persons; this will leave eight inches space in the bath for the water to rise according to the specific gravity of the person bathing.

What we claim as our invention, and desire to secure by letters patent, is the compound standing pipe, as shown and described in the drawings and model, together with the mode of supplying hot and cold water to bathing tubs, by means of the compound standing pipe, &c., and the combination with the same of the overflow pipe, the whole being constructed in the manner and for the purpose described.

LIST OF ENGLISH PATENTS

GRANTED BETWEEN THE 28TH OF JULY AND THE 24TH OF AUGUST, 1841.

Joseph Ratcliffe, of Birmingham, manufacturer, for certain improvements in the construction and manufacture of hinges for hanging and closing doors. August 4; six months. (Being a communication.)

Owen Williams, of Basing lane, London, engineer, for improvements in propelling vessels. August 4; six months.

John Lee, of Newcastle-upon-Tyne, manufacturing chemist, for improvements in the manufacture of chlorine. August 4; six months.

James Warren, of Montague Terrace, Mile End Road, for an improved machine for making screws. August 4; six months.

Stopford Thomas Jones, Tavistock Place, Russell-square, gentleman, for certain improvements in machinery for propelling vessels by steam or other power. August 4; six months.

William Craig, engineer, Robert Jarvie, ropemaker, and James Jarvie, ropemaker, all of Glasgow, in the kingdom of Scotland, for certain improvements in machinery for preparing and spinning hemp, flax, wool, and other fibrous materials. August 11; six months.

Samuel Brown, of Gravel-lane, Southwark, engineer, for improvements in the manufacture of metallic casks or vessels, and in tinning or zincing metal for such and other purposes. August 11; six months.

John Seaward and Samuel Seaward, of the Canal Iron Works, Poplar, engineers, for certain improvements in steam-engines. August 13; six months.

William Hale, engineer, and Edward Dell, merchant, both of Woolwich, for improvements in cases and magazines for gunpowder. August 13; six months.

John Harvig, of the Strand, gentleman, and Felix Moreau, of Holywell-street, Millbank, sculptor, for a new and improved mode or process of cutting or working cork for various purposes. August 21; six months.

John Harvig, of the Strand, gentleman, and Felix Moreau, of Holywell-street, Millbank, sculptor, for a new or improved process or processes for sculpturing, moulding, engraving and polishing stone, metals, and other substances. August 21; six months.

John Thomas Carr, of the town and county of Newcastle-upon-Tyne, for improvements in steam-engines. (Being a communication.) August 21; six months.

George Hickes, of Manchester, agent, for an improved machine for cleaning or freeing wool and other fibrous materials of burs and other extraneous substances. August 21; six months.

Charles de Bergue, of Broad-street, London, merchant, for improvements in axletrees and axletree boxes. (Being a communication.) August 21; six months.

Frederic de Moleyns, of Cheltenham, gentleman, for certain improvements in the production or development of electricity, and the application of electricity for the obtainment of illumination and motion. August 21; six months.

William Walker Jenkins, of Gred, in the county of Worcester, manufacturer, for certain improvements in machines for the making of pins, and sticking the same into paper. August 27; six months.

Edmund Morewood, of Highgate, Middlesex, gentleman, for an improved mode of preserving iron and other metals from oxidation or rust. (Being a communication.) August 27; six months.

Miles Berry, of Chancery-lane, civil engineer, for certain improvements in the means and apparatus for obtaining motive power, and rendering more effective the use of known agents of motion. (Being a communication.) Aug. 27; six months.

Samuel Hardman, of Farnworth, near Lancaster, spindle and fly maker, for certain improvements in machinery or apparatus for roving and slubbing cotton and other fibrous substances. August 27; six months.

Thomas Chambers and Francis Mark Franklin, of Lawrence-lane, London, and Charles Rowley, of Birmingham, button manufacturer, for improvements in the manufacture of buttons and fastenings for wearing apparel. August 27; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22D OF JULY TO THE 22D OF AUGUST, 1841.

James Molyneux, of Preston, Lancaster, linendraper, for an improved mode of dressing flax and tow. Sealed July 28.

Edward Foard, of Queen's Head-lane, Islington, Middlesex, machinist, for an improved method or improved methods of supplying fuel to the fire-places or grates of steam-engine boilers, brewers' coppers, and other furnaces; as well, also, to the fire-places employed in domestic purposes; and generally to the supplying of fuel to furnaces or fire-places in such a manner as to consume the smoke generally produced in such furnaces or fire-places. Sealed July 28.

William Crofts, of Radford Works, near Nottingham, lace manufacturer, for improvements in the manufacture of figured or ornamented bobbin-net or twist lace, and other fabrics. Sealed July 28.

James Shanks, of St. Helen's, Lancashire, chemist, for improvements in the manufacture of carbonate of soda. Sealed July 28.

Richard Beard, of Egremont-place, New-road, Middlesex, gentleman, for improvements in the means and apparatus to be employed for taking or obtaining likenesses and representations of nature, and of drawings, and other objects. (Being a communication from abroad.) Sealed July 28.

John Brumwell Gregson, of Newcastle-upon-Tyne, Northumberland, soda-water manufacturer, for improvements in pigments, and in the preparation of the sulphates of iron and magnesia. Sealed July 29.

James Lee, of Newcastle-upon-Tyne, Northumberland, manufacturing chemist, for improvements in the manufacture of chlorine. Sealed August 3.

Moses Poole, of Lincoln's Inn, Middlesex, gentleman, for improvements in tanning, and dressing or currying of skins. (Being a communication from abroad.) Sealed August 3.

Thomas Spencer, of Liverpool, Lancaster, carver and gilder, for an improvement or improvements in the manufacture of picture and other frames, and cornices, applicable also to other useful and decorative purposes. Sealed August 4.

John Haughton, of Liverpool, clerk, for improvements in the method of affixing certain labels. Sealed August 11.

Thomas Carr, of the town and county of Newcastle-upon-Tyne, being a communication from abroad, for improvements in steam-engines. Sealed August 18.

Ezekiel Jones, of Stockport, Cheshire, mechanic, for certain improvements in machinery for preparing, slubbing, roving, spinning and doubling cotton, silk, wool, worsted, flax, and other fibrous substances. Sealed August 20.